EMERGENT LEADERSHIP STRUCTURES IN ORGANIZATIONS

A Dissertation

by

ANDREW J. SLAUGHTER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2008

Major Subject: Psychology

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ABSTRACT

Emergent Leadership Structures in Organizations. (December 2008)

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A social network approach was used to investigate the structural features of various emergent leadership systems in a large financial organization (n = 137), including transactional and transformational-style leadership relations. Results indicate that macro-level patterns of leadership nominations may be explained by a small number of underlying structural features, some of which vary across types of leadership networks. Leadership nominations were shown to be less hierarchical, more reciprocal, and more triadic than traditionally thought. On top of effects associated with individual differences in sex, supervisor status, tenure, and physical location, leadership networks displayed tendencies towards reciprocity and loose core-periphery structures based on transitive hierarchies. There was also some evidence that transformational leadership networks tended to be slightly less centralized and more transitive than transactional leadership networks. Implications for bridging leadership theory across levels of analysis are discussed.

TABLE OF CONTENTS

Page

LIST OF FIGURES

FIGURE Page

LIST OF TABLES

INTRODUCTION

In order to better meet the challenges of a competitive marketplace and increase productivity, a common theme in organizations has been the increased use of self-managed teams (Black & Lynch, 2004; Dumaine, 1990) and flexible, less hierarchical governance structures (Daft & Lewin, 1993; Evans & Wolf, 2005). Thus, instead of filling relatively stable roles within a clearly delineated organizational structure, employees are increasingly likely to be called on to take informal leadership roles, and to do so under increasing levels of uncertainty. This introduces a number of new perspectives for leadership research and practice.

Managers and employees must learn to deal with situations where group members come from different "social neighborhoods" with porous, ill-specified boundaries. In such groups, formal systems of hierarchical control may crisscross traditional organizational boundaries, and systems of vertical control may be inadequate or counterproductive. With increasing interest in less bureaucratic organizational forms such as network forms of governance (Jones, Hesterly, & Borgatti, 1997), managers may not be able to count on having clearly defined command and control structures, and even when such structures do exist, managers may find that the informal structure lying just beneath the surface of the organization exerts more substantial influence – and offers more potential leverage – than the formal structure (Cross & Parker, 2004). Thus, being able to describe and predict the likely form of informal systems of control and influence may be important for understanding and affecting individual and group behavior in

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This dissertation follows the style and format of the *Journal of Applied Psychology*.

organizations.

For researchers, this change presents several theoretical and analytical challenges. At a theoretical level, self-managed work groups and organic governance structures require updated theories of leadership and influence that can account for emergent relationships[1], and the social structure defined by these relationships. At an analytical level, researchers should be able to identify, define, and properly account for the highly complex patterns of behaviors and cognitive interdependencies that the social structure may engender.

There have been a number of strides forward in addressing these issues in the context of leadership research. For example, some researchers have begun to move away from a vertical leader-centered perspective, and take into account horizontal relationships among followers (e.g., Ford, 2003; Sparrowe & Liden, 1997). Other authors have argued for a conceptualization of leadership as an emergent, distributed phenomenon that is a direct result of individual cognitions and social interaction patterns among group members (Meindl, 1993; 1995; Osbourn, Hunt & Jauch, 2002).

To better understand how informal leaders emerge in organizations and are perceived by others, researchers need to be able to describe the complexities of emergent leadership interactions. By identifying the structural characteristics of emergent leadership networks, a more complete picture of emergent leadership as a complex organization-wide system of control and influence can be developed.

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[1] The term 'emergent relationships,' when used here, refers to informal social ties, not formally prescribed by the organization (Brass, 1984; Ibarra, 1993; and Krackhardt & Stern, 1988).

This paper seeks to make several contributions. First, it will respecify emergent leadership as a process of interpersonal influence involving a network of dyadic interactions. Second, it will identify a number of orderly structural properties displayed by leadership and influence relations, such as reciprocity, balance, centralization, and generalized exchange. Finally, it will demonstrate how leadership type moderates these properties, leading to predictable differences in the structure of emergent transformational and transactional leadership networks.

These issues will be discussed in several sections. In the first section, past theoretical perspectives and empirical research on emergent leadership emergence will be reviewed. Next, important structural characteristics will be identified, defined, and linked to expected properties of emergent leadership networks. These expected properties will then be tested using recently developed statistical models for social networks.

EMERGENT LEADERSHIP

There have been many definitions of leadership, one of the most common of which is *the ability to influence* (Yukl, 1989; Yukl & Van Fleet, 1992). This influence may arise because of formal power vested in the leader, or because of more subtle and informal power to which they have access (Fernandez, 1991; Friedkin, 1993; Hollander & Offermann, 1990). A significant portion of leadership research has focused on leader *effectiveness* – specifically, the behaviors, characteristics, and contexts that lead to successful leadership and the effective exercise of the leader's influence and control. Another major area of leadership research has focused on the study of leadership *emergence*.

Leadership emergence is defined as the process by which individuals come to be perceived as a leader by others in their group (Hogan, Curphy, & Hogan, 1994). It is related to the way that status is accorded by group members to one another (e.g., Campbell, Simpson, Stewart, & Manning, 2002), and how systems of informal control and influence emerge within groups and organizations (Sell, Lovaglia, Mannix, Samuelson, & Wilson, 2004). One result of this process is the existence of informal leaders, individuals who are able to influence others, but who do not necessarily have the most formal power in the group (Friedkin, 1993; Wheelan & Johnston, 1996); for example, managers may have a great deal of formal power and authority, but not necessarily the greatest amount of informal influence over other group members. According to this conceptualization, it is the ability to access or exercise this informal influence which defines a group member as an emergent leader.

Emergent leadership represents a potential problem for organizations, because it is largely outside of formal control. Organizations spend a reported $15-50 billion each year on leadership training (Raelin, 2004; Rifkin, 1996) in an attempt to improve the ability of their managers and executives to guide the organization and influence subordinates. In this respect, the existence of informal leaders potentially undermines that investment, since such informal leaders may have their own goals and agendas not necessarily aligned with those of the organization.

Moreover, attempting to avoid the creation of emergent leaders and informal systems of influence may not be possible, or even desirable. Emergent, informal relations arise as the result of individual adaptation to challenges and issues in the environment, as well as needs that may not be fulfilled by the formal structure (Chisholm, 1992; Roethlisberg & Dickson, 1939). For example, workers on an assembly line team may be formally expected to report problems to managers, but issues with punishment or reprimands may lead them to seek information or resolution through alternative channels, such as knowledgeable co-workers.

In the case of leadership, emergent leaders may provide valuable support and guidance to employees when formal leadership is lacking or unavailable. Informal leadership may also enhance organizational flexibility and stability by providing alternative governance mechanisms capable of more rapid adaptation to changes in the local environment. In this sense, the system of informal influence provided by emergent leadership structures in organizations represents a potential resource – a kind of system-

level capacity for leadership where multiple leaders may emerge, and any number of people may wield influence over others.

Background

The traditional focus of emergent leadership research has been the identification of individuals in small groups most likely to be perceived as a leader, and the measurement of these individuals' characteristics. Within this context, there have been two general approaches to the kind of variables researchers have chosen to study: structural and psychological.

Structural antecedents. Research on communication, game theory, and social capital suggests that an individual's position in the social structure has important implications for an individual's actual and perceived influence. Structural variables such as centrality are thought to affect influence and leadership perceptions by controlling how much knowledge individuals may have about the group, how many resources they are able to access, the speed of resource mobilization, and how much control they are likely to have over others' access to such resources.

Examining a workflow network, Brass (1984) found that ratings of perceived influence were correlated 0.39 with closeness centrality (how close an individual was with all network members, on average) in workgroups and 0.33 with betweenness centrality (how frequently, on average, an individual served as an intermediary between others in the network) in departments. Both closeness and betweenness in the department communication network were related to ratings of influence by others ($r = 0.35$ and

0.46). A study by Fombrun (1983) found that closeness centrality was a significant predictor of perceived power.

A meta-analysis of small group communication networks by Mullen, Johnson, and Salas (1991) found that the three types of centrality (degree[2], betweenness, and closeness) correlated with leadership nominations 0.36, 0.38, and 0.38 respectively. Krackhardt (1990) showed that managers' betweenness centrality in advice and friendship social networks significantly increased the ability to predict individual ratings of influence ($\Delta R^2 = 0.17$) above and beyond formal position in the organization. Similarly, Freeman, Roeder, and Mulholland (1980) found that all three types of centrality predicted leadership nominations. Brass and Burkhardt (1993) reported that degree centrality in the task-related communication network had a significant effect on perceptions of influence, although this effect varied depending on the type of influence tactics commonly used. Most recently, Bono and Anderson (2005) found that transformational leaders are more central in organizational advice and influence networks.

Psychological antecedents. Another major approach to studying leader emergence, prevalent in the field of psychology, is the study of individual behaviors and characteristics that result in influence and perceptions of leadership. This approach is supported by research on leadership categorization theory (Lord, Foti, & de Vader, 1984). According to this theory, each individual has an implicit theory of leadership or

[2] Degree centrality is the number of connections a node has; that is, a node with 4 connections would have degree 4. Directional relations allow for the specification of two different types of degree centrality: in-degree and out-degree centrality. These describe the number of connections received by an actor and sent by an actor, respectively.

schema which includes a number of traits and behaviors, and those individuals who most closely match the prototypical leader are more likely to be perceived as a leader (Hains, Hogg, & Duck, 1997; Offerman, Kennedy, & Wirtz, 1994; Weiss & Adler, 1981). To the extent there may be a number of commonly endorsed leader attributes (House & Aditya, 1997), individuals with those attributes should be perceived as leaders more frequently than those without. Indirectly supporting this view, Kenny and Zaccaro (1983) found that between 50% and 80% of the variance in small groups' ratings of perceived leaders could be explained by stable individual differences.

Much of this research has focused on individual skills and behaviors. For example, some research has shown that emergent leaders tend to engage in a wider variety of influence tactics (Howell & Higgins, 1990), including more assertive influence techniques (Madden, 2001). They also tend to engage in greater amounts of communication (Riggio, Riggio, Salinas, & Cole, 2003; Watson & Hoffman, 2004). Individuals perceived to have greater task competence or skill are more likely to emerge as leaders (De Souza & Klein, 1995), as are those who have greater intelligence (Lord, de Vader, & Alliger, 1986).

Other research has focused on individual differences such as intelligence, personality, and sex. This work has shown that individuals with greater intelligence are much more likely to be perceived as leaders (Lord et al., 1986). A number of narrow personality constructs have also been linked to leader emergence, including masculinity-femininity, adjustment, dominance, and conservatism (Lord et al., 1986); self-monitoring (Cronshaw & Ellis,1991; Zaccaro, Foti, & Kenny, 1991); need for

achievement and need for affiliation (Sorrentino, 1973; Sorrentino & Field, 1986). At a broader level, neuroticism, conscientiousness, extraversion, and openness to experience all predict leader emergence (Judge, Bono, Ilies, & Gerhardt, 2002). Finally, research has found that sex and gender roles may play a factor in leadership perceptions, with men tending to be perceived as leaders more often than women (Eagly & Karau, 1991).

A new approach to emergent leadership research

The issue of informal leadership emergence has been approached from a number of theoretical perspectives. This research has produced several important findings about the characteristics or social positions that increase the likelihood of being perceived by others to possess influence or be a leader. However, despite fairly strong findings related to individual characteristics and social position, a number of potentially significant limitations remain.

One limitation is that emergent leadership research has largely failed to incorporate theoretical advances from other areas of leadership research (De Souza & Klein, 1995; Kickul & Neuman, 2000). For example, theories such as Leader-Member Exchange (LMX) and transformational leadership have received a wide range of support, but have not usually been used to address research questions in the leadership emergence literature. This divergence is not without reason. Many theories of leader effectiveness do not have clear applications to informal leadership emergence phenomena (Mahar & Mahar, 2003).

One result of this lack of integration is that leadership emergence has tended to rely on extremely broad perceptual measures, such as whether or not an individual

"exemplifies strong leadership" (Taggar, Hackett, & Saha, 1999) or "is most like a leader" (Johnson & Bechler, 1998). Although such measures are valid, the over-reliance on what might be termed *global* ratings of leadership emergence make it even more difficult for emergent leadership research to take advantage of the many classifications derived from leadership effectiveness research, such as the distinction between transformational and transactional leaders.

The second – and arguably more critical limitation – is that leadership perceptions have been studied primarily in terms of an individual-level, leader-centered phenomenon (Gronn, 2002). Although leadership is frequently acknowledged to be a kind of interpersonal relationship (e.g., Brown, 2000; Popper, 2004), it is not usually measured as such. Instead, it is treated more as a generalized role that people with certain characteristics are more or less likely to fill. Even the growing number of studies involving structural position such as centrality (e.g., Bono & Anderson, 2005, Mullen et al., 1991) focus on leadership as an individual-level outcome. The end result of this narrow focus is an extremely good picture of *emergent leaders*, but not necessarily the most complete understanding of *emergent leadership systems*. Many human social ties display a variety of complex structural patterns that go beyond the individual level of analysis (Lazega & Pattison, 1997; Watts & Strogatz, 1998). Whether emergent leadership and influence relations display such complexities remains an open question.

EMERGENT LEADERSHIP STRUCTURES

Despite the focus on emergent leadership as an individual-level phenomenon (Gronn, 2002), there are substantial reasons to believe it is best conceived as a multi-level relational construct. Failure to take this aspect of emergent leadership into account has a number of implications for theory and practice. By using social network analysis, it is possible to identify a number of different patterns in leadership networks that represent important relational tendencies governing the formation of leadership relations in organizations.

One of the primary reasons for treating leadership as an interpersonal relationship between an "emergent leader" and "emergent follower" is conceptual. By definition, it would be impossible for a person to emerge as a leader outside of a social group; it would make no sense to speak about an individual, stranded alone on a desert island, emerging as a leader. The very concept of leadership implies at least a dyadic relationship – a direct tie shared by two people, a leader and a follower. This sort of reasoning has been used by previous authors to suggest that leadership is not embedded in individuals or even in single roles, but represents a relational process, shared between group members, and embedded in the social context (Osbourn et al., 2002; Yukl, 1998; Yukl & Van Fleet, 1992).

To make matters more complicated, these dyadic relationships do not form in a social vacuum. Leaders influence others through both direct and indirect means (Osbourn et al., 2002), and one person's choice of a leader may depend on the choices and behaviors of others in the network. Thus, relational choices may be interdependent,

as leadership relations form according to general social rules and cognitive mechanisms. These rules can result in specific types of structural patterns, which can provide important information about the level and type of interdependence in the network.

This type of relational data has the potential to be used for a wide variety of purposes. It can be used to test theories about the ways in which individuals and groups form, compete, and cooperate with one another. It can also be used to study the level of efficiency and redundancy in various social and technical systems, the tendency to form or avoid various types of coalitions, or the stability and resiliency of emergent, informally-specified relationships and particular structural forms. When combined with relevant actor-level data such as individual characteristics or outcomes, this information can be used to study ways in which knowledge and attitudes spread through groups, how particular aspects of social structure affect outcomes like performance, or how individuals select others with whom they interact.

Because these structural tendencies have important implications for the properties of the informal control and influence mechanisms that exist outside of the formal organizational structure, it is important to identify some of the basic structural properties of emergent leadership networks. Identifying these characteristics will help organizations better understand the ways in which informal control mechanisms could support or inhibit formal hierarchical decision-making; it could also provide a description of some of the basic structural patterns that future theories of leadership emergence should be able to explain.

Social network analysis

Handling relational data can be difficult because it can easily violate assumptions of independence in ways that are not addressed by more traditional techniques, such as hierarchical linear modeling (HLM). Social network analysis (SNA) provides a way to handle these data, allowing researchers to identify and control for complex dependencies which may exist at dyadic, triadic, or higher levels of analysis. Rather than focusing on the characteristics, attitudes, or behaviors of independent groups and individuals, network analysis focuses on interactions between individuals, and treats these interactions as important in their own right (Wasserman & Galaskiewicz, 1994). For example, interpersonal interactions can provide conduits for the flow of information or resources, or help to define the social environment which constrains and potentiates behavior (Wasserman & Faust, 1994). This relational analysis can be extended to include group and individual characteristics, and how these characteristics are embedded within the network of ties.

A social network consists of a set of actors (or nodes) and the relationships (or ties) between them (Wasserman & Faust, 1994). Actors may be individuals, groups, or even entire organizations. Ties may represent any kind of relationship (e.g., communication, friendship, influence, conflict), and may be directional or non-directional, and valued or binary. These ties may be studied at multiple levels of analysis (Monge & Contractor, 2003), providing different information about the relational tendencies that define the social structure and influence individual behavior and perceptions.

The lowest level of analysis deals with individual actors and their place in the social structure. At this level, researchers may be interested in actors' positions in the overall network, or what role they have. The numerous measures of centrality and prestige (e.g., closeness, betweenness, degree, etc.) are all individual-level measures, used to describe various aspects of an individual's connections and relative importance in the network. The majority of research on leadership and social structure has focused on this level of analysis, using individual position (i.e., centrality) in friendship, advice, and communication networks to predict leadership outcomes.

At the dyadic level of analysis, researchers focus on the factors associated with relationships that form between pairs of individuals. This may include a wide variety of structural tendencies: the tendency for *homophily*, where individuals who are tied to each other tend to share similar attributes or characteristics; or the tendency to form reciprocal relationships, where actors respond to ties in kind.

The triadic level of analysis deals with structural tendencies involving three actors. At this level, researchers may be interested in the extent to which individuals form various types of clusters. Such triads can provide information on different aspects of hierarchy and local clustering, and can be used to test theories related to cognitive dissonance, social exchange, brokerage, or coalitional behavior (Degenne & Forse, 1999; Monge & Contractor, 2003), among others. Higher levels of analysis can provide

information on how those clusters are spread across the network, or uncover the existence of larger patterns like core-periphery structures[3].

Random graph configurations

Many of the important relational tendencies at the dyadic and triadic level can be represented by a number of specific graph configurations. These graphs represent different kinds of local configurations which may be observed in a given social network. These configurations may be embedded in one another – for example, individuals are nested within dyads, dyads are nested within triads, and triads are nested within the larger networks. Although these lower-order patterns represent important structural tendencies in and of themselves (Lazega & Pattison, 1999; Van de Bunt, Van Duijn, & Snijders, 1999), equally important is their ability to describe how macro-level features such as density, centralization, core-periphery structures, or small-world networks[4] arise from micro-level patterns (Laumann & Marsden, 1982; Robins, Pattison, & Woolcock, 2005). Some of the common random graph configurations are described below, and shown in Figure 1.

[3] Core-periphery networks are defined by a small set of tightly connected central actors (the core) surrounded by a loosely connected set of peripheral actors (the periphery).

[4] Small-world structures are the reason for the "six degrees of separation" phenomenon, the empirical finding that in many networks, any actor can be reached from any other actor in the network in an average of only six steps. Even in very large networks, small world properties (clusters joined by random connections) allow for connections between any two actors by going through a relatively small number of intermediaries.

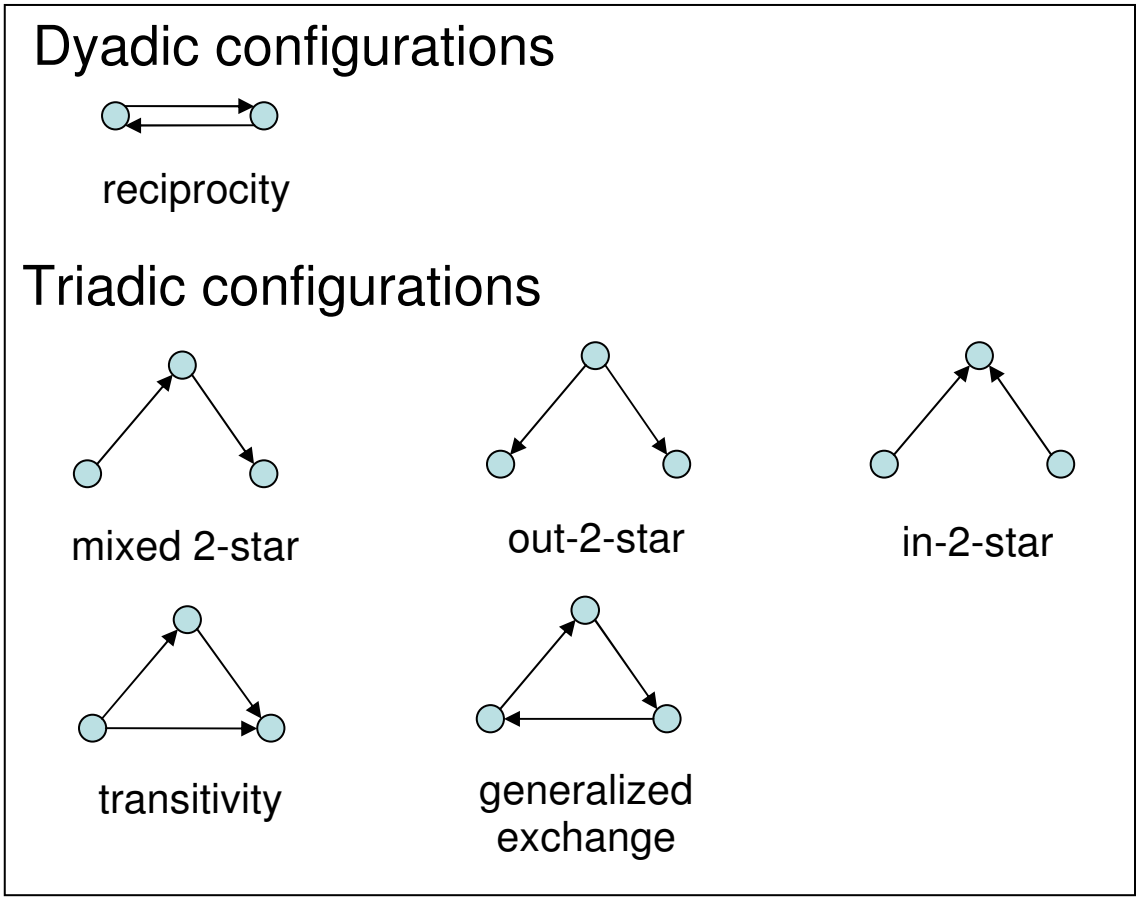


Figure 1. Example random graph configurations. These configurations represent lower-order structures which may be used to explain overall patterns of relationships in the global network.

Reciprocity (see Figure 1) is the tendency for two actors to form a dyad in which each selects the other as a network partner. Reciprocity is one of the most basic and important structural features of networks, with a number of implications for group and individual-level outcomes. Reciprocity in various networks has been shown to lead to increased trust (King-Casis et al., 2005); better mental and physical health (Jou & Fukada, 1996); more organizational commitment, perceived organizational support, and

increased altruism (Uhl-Bien & Maslyn, 2003) and to ease the formation of subsequent exchange relations (King-Casis et al., 2005). In the case of leadership relations, this would be the tendency for two people to mutually regard one another as leaders.

In-star configurations represent the tendency for some actors to receive multiple connections from other nodes. In this context, it is similar to the concept of in-degree centralization, and represents variability in the centrality or in-degree of actors – the tendency for some people to be selected as a partner much more often than others. Out-star configurations represent an analogous effect, related to out-degree centralization, where there is significant variation in the extent to which actors select multiple partners.

These effects are most often defined using *2-star* configurations (shown in Figure 1) - stars of degree 2, but accurate modeling of the degree distribution may require the inclusion of multiple higher-order star terms (for example, stars of degree 3 and 4). More recently, researchers have defined a single term (*alternating k-stars*) to capture the effects of multiple higher-order star configurations simultaneously. This term (Snijders, Pattison, Robins, & Handcock, 2006) models the degree distribution, and places appropriate weight on lower-order stars, which are more likely to occur in typical social networks. Positive k-star parameters indicate larger variance in the distribution of degrees, with several high-degree and many low-degree actors. Negative k-star parameters indicate a variable degree distribution, with few high-degree nodes. In terms of leadership, these k-star configurations would represent a tendency for high levels of variability in the extent to which some actors nominate (out-stars) or are nominated (in-stars) as leaders by others.

Mixed-2-stars are a configuration that describes the tendency for "bridge" relationships to form, or for two actors to connect only indirectly. This may result from a third party seeking an advantageous brokerage position over the other two, or from social pressures creating the need for a coordinator or liaison (Degenne & Forse, 1999). Forming and maintaining multiple sets of dyadic relations may require significant investments in the form of time and energy. Brokers who possess many ties may facilitate connections between otherwise unconnected actors (Gould & Fernandez, 1989; Marsden, 1982; Thurmaier & Wood, 2002), increasing the efficiency with which connections can be made between any two points in the network.

Just as there is a configuration designed to capture the effects of multiple higher-order star configurations, there is also a term designed to capture higher-order 2-path configurations, *alternating k-2-paths*, in which an actor *i* connects to an actor *j* indirectly via some number (*k*) of intermediaries. This term is especially important because it captures the necessary preconditions for transitivity (described below) and aids in their interpretation. However, it can also represent an important structural feature in its own right. For example, in the case of leadership networks, a significant *k*-2-path term could represent the tendency for multiple third-party "influence brokers" to bridge pairs of individuals.

Transitivite triads are a particular type of triangle configuration which can be interpreted in terms of both affective balance (Wasserman & Faust, 1994) and linear hierarchy (Chase, 1980; Monge & Contractor, 2003) due to differential popularity or status (Feld & Elmore, 1982). In simple terms, transitivity represents the tendency for

"friends of my friends to also be my friends." Snijders et al. (2006) discuss a higher-order term designed to model transitivity, referred to as an alternating transitive *k*-triangle. This term captures the tendency for transitive triangles that occur in larger-scale clusters, instead of randomly spread throughout the network. In terms of leadership, such structures may represent a tendency for leaders and influential actors to cluster together in certain ways.

Generalized exchange or *cyclicity*, as the name implies, is a generalized case of restricted exchange. Instead of being restricted to a dyad, the exchange may go through more than one person. In the simplest sense, it is the tendency described by the saying "what goes around, comes around." A generalized exchange relationship in the case of leadership would imply that followers of roughly equal status may be recognized as leaders indirectly.

Characteristics of emergent leadership networks

The specific configurations associated with emergent leadership have major implications for the way such networks form in organizations. For example, if emergent leadership networks have a strong norm of reciprocity, then actors who do not reciprocate – who never "accept" influence by others – would violate the norms of the group. These individuals may find themselves gradually isolated from the informal influence structure, as their influence attempts are rebuffed. Actors who encourage the influence attempts of others may find themselves with increasing opportunities for exercising leadership and influence within the organization. However, if the tendency

towards reciprocity was *too* strong, then each actor would influence everyone else, and there would be no clear leaders.

If leadership and influence networks are highly centralized due to indegree, then some actors will tend to have much more influence and receive many more leadership nominations than other actors. Such a network may be efficient, minimizing the number of competing or redundant lines of influence, but the loss of one or two key actors may "disconnect" all influence relations in the network. This type of network may therefore be fragile and easily disconnected. In many ways, this type of network would represent an organization with a very low capacity for leadership (Day, Gronn, & Salas, 2004).

Of all possible types of structural features emergent leadership networks could display, the concept of *hierarchy* has tended to dominate the way both theorists and laypeople conceive of the construct. Writers as early as the 1840's defined leadership in explicit terms of vertical hierarchies, and this conceptualization has persisted to become the "traditional" view of leadership (Brown, 2000; Chepko-Sade, Reitz, & Sade, 1989; Pearce & Conger, 2003), with some suggestion that hierarchical structures may be a natural response to pressures for efficiency (Kontopoulos, 1993; McBride, 2006) or competition within status and power structures (Chase, 1980; Kontopoulos, 1993).

In this view, leadership is a top-down process, often focused in a single individual who dominates the rest of the group (Mehra, Smith, Dixon, & Robertson, 2006). If emergent leadership is truly defined by clear vertical hierarchies with strict (but perhaps unspoken) chains of command, then the traditional emergent leadership research

paradigm makes a good deal of sense. In such a structure, predicting who will climb to the top of the pyramid also lets you know who will be at the bottom.

The prototypical structure represented by this effect is known as a *star network*, shown in Figure 2. In larger groups, vertical hierarchies are often expected to take the form of tree-like structures, which involve large numbers of star-like structures chained together. In terms of local configurations, such a structure represents a strong tendency towards in-star configurations (i.e., high in-degree variance) and against reciprocity. In the case of leadership, such a network represents the emergence of a single influential leader.

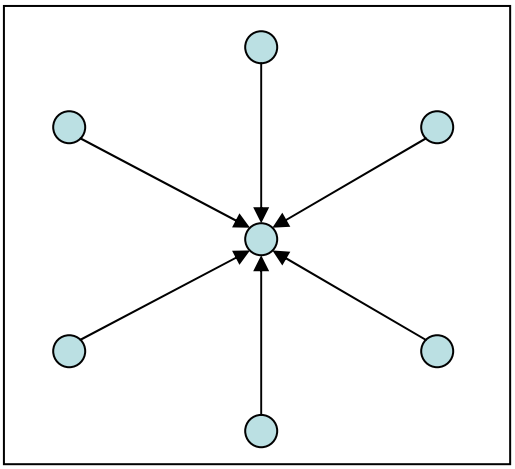


Figure 2. Star network.

However, a strict vertical hierarchy with one emergent leader and many followers seems relatively unrealistic for most groups. Research has shown that multiple leaders may sometimes emerge, even in small groups (Bales, 1958; Mehra et al., 2006;

Neubert, 1999). Moreover, research on power and status structures finds that even groups of simple animals can have complex pecking orders, exhibiting structural characteristics beyond simple centralization (Chase, 1980) or dyadic effects like reciprocity (Faust, 2007). Research on influence tactics and game theory suggests a number of possible "third party" effects, as individuals and groups compete and coalesce over time (Van Doorn, Hengeveld, & Weissing, 2003).

Which characteristics are likely to be important to emergent leadership networks? Assume that individuals vary in terms of status or influence-related characteristics and that status and influence are positively related. If high status is more desirable than low status (Jameson, 1945), and influence can be used as a substitute for (Westphal & Stern, 2006) or to increase status (Madden, 2000) in leadership positions, then theory suggests a number of specific structural configurations which are likely to define networks of emergent leadership and the patterns of informal influence which characterize them.

Centralization. Organizations are not composed of identical, homogenous actors. They are composed of people who vary across a wide range of individual characteristics. Actors may have different traits and skills, enter the organization at different points in time, have different jobs and roles, and have different places in the organizational hierarchy.

Individuals may differ in characteristics that are *directly* associated with leadership perceptions. They may possess more leadership-related traits (Lord et al., 1986), or they may be closer to some idealized group prototype than other actors (Hains,

Hogg, & Duck, 1997; Hogg, 2001). Some actors are more talkative or more skilled, and leadership nominations and influence may be distributed accordingly, resulting in significant variation in leadership nominations across actors in the organization.

Individuals may also differ in characteristics that are *indirectly* related to leadership. According to status characteristics theory (SCT), individual differences may be associated with perceptions of status and performance expectations (Simpson & Walker, 2002). Differences in status characteristics lead to social stratification, the emergence of status and power hierarchies (Fisek, Berger, & Norman, 1991), and patterns of unequal influence (Ravlin & Thomas, 2005). High status actors are more likely to use a variety of influence tactics (Brass & Burkhardt, 1993; Han, 1996), have greater influence (Oldmeadow, Platow, Foddy, & Anderson, 2003), be considered experts (Bunderson, 2003), be provided initial opportunities for performance (Fisek et al., 1991; Shelly & Troyer, 2001), and receive more favorable outcomes in social exchanges (Cook, Emerson, Gilmore, & Yamagishi, 1983; Thye, Willer, & Markovsky, 2006). This represents a potential "rich get richer" effect, where initial status differences translate into competitive advantage as actors struggle for status and influence, indirectly leading to significant variability in the number of leadership nominations received by members of the organization. To the extent that leadership networks are based on highly centralized networks surrounding a few key individuals:

Hypothesis 1: Leadership networks should display significant positive tendencies towards degree-based centralization, representing an in-degree centralization effect.

Transitivity. Another micro-level structure likely to occur in emergent leadership networks is transitivity. Past work on behavior in many different animal groups, including humans (Chase, 1980; Faust, 2007) as well as recent multiplayer game-theoretic research suggests that emergent power and status hierarchies may be explained by an evolutionary, emergent process of repeated social exchanges or dyadic "tournaments" (Van Doorn et al., 2003) with third-party bystander effects (Skvoretz, Faust, & Fararo, 1997), resulting in transitive hierarchies[5]. Transitive structures represent an alternative to the fully-ordered vertical hierarchies represented by stars and trees; sometimes referred to as a "heterarchy" (Kontopoulos, 1993), a transitive structure can represent a partially-ordered hierarchy, in which not all relationships are fully nested within one another (as they would be within a tree-type structure). Structures such as this may arise when relationships are not required to be fully nested within each other, as in a tree structure: e.g., when actors in the hierarchy are allowed to form direct ties with others' subordinates (including their subordinates' subordinates), when subordinates at a given level are allowed to influence one another directly, or when subordinates perceive (and report) indirect influence and leadership from their supervisors' supervisor.

According to simulation work by Van Doorn et al. (2003), if a status system were purely the result of independent contests or comparisons between individuals, such systems would display no tendencies towards transitivity, contrary to empirical observations (Sade & Dow, 1994). Moreover, they suggest that the existence of such transitive structuration cannot be explained by individual differences in resource

[5] In the simplest case, if A dominates B, and B dominates C, then A should also dominate C – a classic case of transitivity, representing an ordered hierarchy of social relations.

potential – that is, individual differences in skills, abilities, or other status characteristics may not be sufficient to explain the existence of stable, strongly transitive hierarchies. They argue that individual status hierarchies are based on competitive processes at two different levels: within-dyad competition that results in intra-dyadic power asymmetries, and between-dyad competition that results in inter-dyadic asymmetry, resulting in transitive hierarchies.

Such game-theoretic logic for transitivity in emergent leadership networks is bolstered by research on balance theory (de Nooy, 1999; Hummon & Doreian, 2003). According to balance theory (Heider, 1958; Cartwright & Harary, 1956), individuals are motivated to maintain cognitive consistency and avoid conflict by altering their cognitions about (or relationships with) other people. In the case of friendship, if A is friends with B, and B is friends with C, then it would be cognitively inconsistent for A to not consider C a friend. Balance theory is most clearly applied to affective relationships with clear positive and negative sides (e.g., like/dislike relations), but Heider (1958) and later theorists also noted that that balance theory includes so-called "unit" relationships (Arkin & Burger, 1980; Davis, 1963). Unit relationships represent a cognitive pairing between two units, where two things are perceived to belong together in some way. Typical examples include perceived similarity, physical proximity, kinship, or sharing a common fate (Arkin & Burger, 1980). In this sense, follower perceptions of individual leadership and influence can be seen to represent a "unit" relationship: a leader-follower pairing, as perceived by the follower. However, leadership ratings are also known to include affective components (Brown & Keeping, 2005).

Thus, leadership may be defined by a given individual in affective terms, in purely relational terms, or in some combination of both. However, no matter which aspect of leadership dominates, we would expect that patterns of perceived leadership relations would be partially explained by balance theory. In the case of perceived leadership, balance theory would suggest that the leader of an influential person may be accorded some degree of influence indirectly. If A considers B to be influential, and B considers C to be influential, then A would be placed in conflict with B unless one of two things happened: A changes their attitude towards B (e.g., "Maybe B isn't quite the leader I thought they were if they follow someone like C!") or A changes their attitude towards C ("If B is willing to follow C, then maybe I should, too.") In either case, it suggests the following hypothesis:

Hypothesis 2: Leadership networks should display significant positive tendencies towards *transitivity*.

Coalitions, reciprocity, and generalized exchange. While competition for status and influence can drive people apart through competition and lead to hierarchy, it can also bring people together through coalitional behavior. Coalition formation is a tactic by which sets of individuals may band together to increase their power and influence. Through coalitions, relatively low-status actors may maximize their own influence (Michener & Lyons, 1972) and reduce power inequalities (Simpson & Macy, 2001). Thus, coalitions are more likely to form in groups where power is distributed unequally (Mannix, 1993).

The formation of small, stable sets of cooperative actors creates an interesting possibility: the existence of emergent leadership coalitions. A simple example of a network coalition can be seen in Figure 3. As shown in the figure, leadership coalitions represent tendencies for sets of actors to emerge as leaders and exercise joint influence within the network – for example, subordinates coming together to influence their manager. Thus, coalitions may be represented by a tendency to form leadership clusters from which multiple members exercise influence over the same followers.

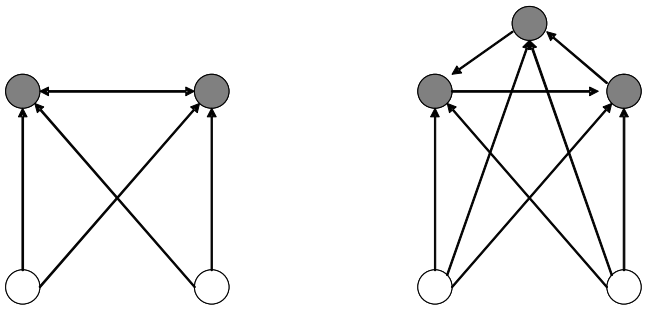


Figure 3. Coalitional leadership structures with supporting processes. Grey nodes indicate leaders (coalition members), white nodes indicate followers.

This type of coalitional activity may be represented by the combination of several more basic network structures, including transitivity, out-stars, and 2-path effects. For example, Snijders et al. (2006) suggest that certain kinds of clustering may be represented by a positive level of transitivity combined with a negative *k*-2-path effect – such a structure will tend to produce several clusters of transitive triads with few indirect connections outside of those clusters. It will also tend to produce actors who send nominations to multiple interconnected leaders. In this sense, coalitional structures

will tend to be opposed to the basic in-degree centralization effect proposed in Hypothesis 1, and to the extent that such coalitional structures exist within the organization, then:

Hypothesis 3: Leadership networks should display a combination of a positive tendency towards transitivity (H2) and a negative tendency towards independent 2-paths (*k*-2-paths).

To support the formation of coalitions, actors should be able to expect the support of others (Lawler, 1975). Groups must also be able to avoid conflict and harm within the coalition and enhance solidarity and trust (Van Beest, Van Dijk, De Dreu, & Wilke, 2005; Michener & Zeller, 1972) – failure to do so leads to mistrust, lack of cohesion, and instability in the coalition. If coalitions exist in stable long-term relational networks, then there should also be evidence of social processes that support their existence. Research on coalitions has identified two important mechanisms which could play this role: *reciprocity* (Berg, Dickhaut, & McCabe, 1994) and *generalized exchange* (Takahashi, 2000).

Hypothesis 4: Leadership networks should display significant positive levels of *reciprocity*.

Hypothesis 5: Leadership networks should display significant positive levels of *generalized exchange*.

Leadership type as structural moderator

However, structural characteristics such as these (e.g., reciprocity, centralization, or others) may vary significantly depending on the specific type of leadership ascribed to

an emergent leader. Research on leadership perceptions has focused almost entirely on leadership as a broad, global characteristic. Other research provides evidence for several distinct types of leadership. One of the most popular models distinguishes between *transformational* and *transactional* leadership.

Originally developed by Burns (1978), transformational leadership is described as the ability to recognize and exploit followers' needs and motivations, and to satisfy their higher-order needs. Burns suggested that the counterparts to transformational leaders were transactional leaders – individuals whose relationship to followers was primarily one of leader-initiated tit-for-tat exchange – for example, in the case of politics, the exchange of political support for financial support.

Transformational leaders model idealized role behaviors, help organizational members to focus on others (such as the organization or the leader themselves), and empower their followers by stimulating learning, experimentation, and risk-taking (Torpman, 2004). Transactional leaders help others to understand the contingencies associated with behavior, execute those contingencies, and identify and correct significant deviations from expected behaviors (Torpman, 2004). Transactional leadership focuses on the maintenance of dyadic exchange relationships that cater to followers' self-interest (Bass, 1999).

Transformational leadership focuses primarily on perceived relationships and outcomes between potential leaders and others in the group. This is not limited (explicitly nor implicitly) to specific individuals who occupy a formal organizational

role. Rather, any actor who develops "transformational" relationships is, by definition, a transformational leader.

Transformational leadership is believed to be contagious; followers and others are thought to become more transformational through exposure to transformational leaders (Bass, Waldman, Avolio, & Bebb, 1987) in a dyadic process (Yukl, 1989). Transformational leaders tend to form relationships based on their own values, not with regard to social expectations (Kuhnert & Lewis, 1987), and use a number of influence mechanisms (Charbonneau, 2004; Torpman, 2004) not explicitly tied to hierarchical status like manager-subordinate relationships.

Because of these differences, we might expect transformational and transactional leadership networks to evolve differently in organizations over time. Take two equivalent networks (Figures 4a and 4d), one with a central transformational leader, and the other with a central transactional leader. Over time, the transformational leadership network may develop in surprising ways, as exposure to transformational leaders affects the formation of future transformational relationships (Figures 4b and 4c) while the transactional leadership network remains relatively static (Figures 4e and 4f).

Reciprocity and transitivity. One of the principal conceptual differences between transformational and transactional leadership networks is the extent to which they are likely to be transitive and asymmetric. In many ways, transformational and transactional

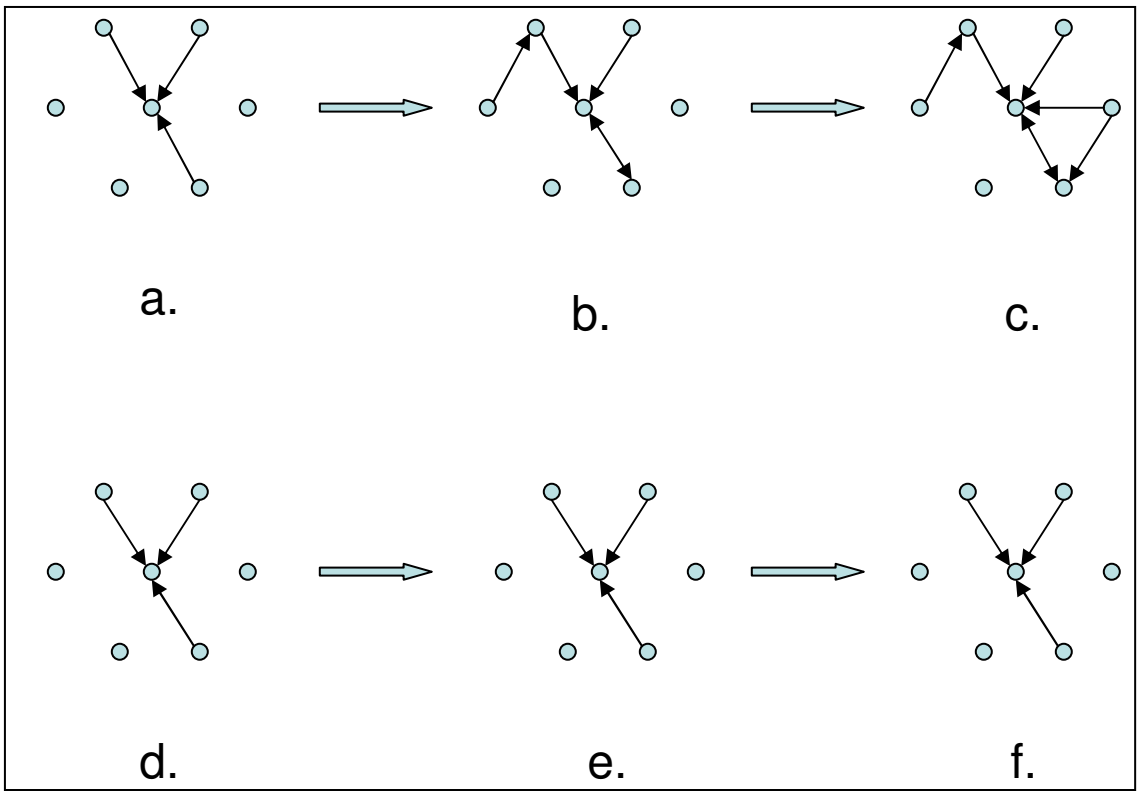


Figure 4. Hypothetical development of transformational and transactional leadership networks over time.

leadership both represent a kind of exchange process. Transactional leaders provide rewards and punishments, transformational leaders provide guidance and motivation, but in both cases these resources lead to influence over others. The difference is found in the potential effect these exchanges have on followers.

Conceptually, the end result of transformational leadership relations are followers who feel empowered and motivated to act (Bass, 1999), and are more likely to become transformational leaders themselves. In this sense, being the follower of a transformational leader ought to accrue real benefits to the follower over time, one of

which is an increase in the followers' own level of influence and the extent to which they are seen as a leader in their own right. At the dyadic level, this implies an increased tendency towards reciprocity (Figure 5a), as transformational leaders recognize similar leadership in their followers. At the triadic level (Figure 5b), this implies a tendency for transitive ties to form, as third parties recognize the informal leadership of both the original transformational leader and their "empowered" follower, and become a follower themselves, adding another layer of hierarchy. By contrast, the end results of transactional leadership exchanges are followers who are dependent or beholden to the leader. In such a situation, followers are no more likely than anyone else to be considered emergent leaders.

Hypothesis 6: Transformational leadership networks should display greater levels of *reciprocity* than transactional leadership networks.

Hypothesis 7: Transformational leadership networks should display greater levels of *transitivity* than transactional leadership networks.

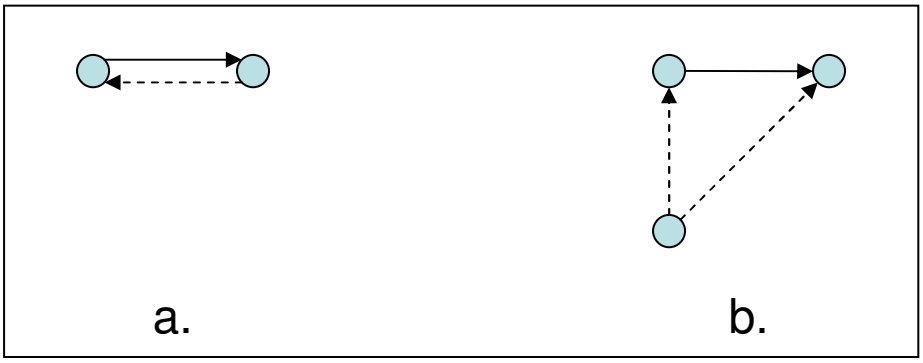


Figure 5. Reciprocity and transitivity in transformational leadership relations.

METHOD

Participants

One hundred forty-three (143) members of a small southern financial institution were surveyed. Of these, 137 individuals responded (a 96% response rate), of which 65% were female, primarily white (95%). Many of the individuals in the sample were older (65% were over 35[6]; 22% were between 24 and 35), and most individuals in the organization had been there for several years: 55% of the sample had a tenure greater than 5 years, although a sizeable number of individuals (18%) had been with the organization a year or less. The sample also included 55 supervisors and 13 officers in the organization. The organization consisted of 11 different geographic locations dispersed across a state. Location was coded using a categorical variable.

Measures

Survey instruments distributed to members of the organization included seven sociometric items (six leadership questions representing three types of leadership relations, and one friendship question), as well as questions about sex, age, ethnicity, supervisory position, and tenure. Tenure was broken into three categories: less than 6 months, less than 1 year, less than 3 years, less than 5 years, and more than 5 years. The three leadership networks in the study were measured using items adapted from Mayo, Meindl, and Pastor (2003). See Appendix C for details. Participants were explicitly told

[6] Tenure was measured using a 5-category response representing broad ranges of tenure (e.g., 0-2 years). Previous experience with similar network studies indicated that it took some people significant lengths of time to generate a number. Given the length of the survey, it was decided to provide broad categories to speed responding. Age was measured using a similarly categorized variable for the same reason. Because there was little variance in age as measured, it was not included as a covariate in the random graph models being tested.

to answer items without regard for individual's level of formal authority, and given examples of such behavior.

Global leadership. The first network represented an overall (or "global") rating of interpersonal leadership relations between each member in the organization. To create this network, two separate sociometric items were used to provide network measures of global leadership and influence ratings:

1) To what extent does person [X] influence your opinions, attitudes, or behaviors?
2) To what extent does person [X] provide you with what *you* consider to be leadership?

Transactional and transformational leadership. To construct network measures of leadership based on transformational and transactional-type relationships, sociometric items were constructed based on current definitions of each type of leadership. According to Bass and colleagues (Bass, 1999; Bass et al., 1987), transformational leaders "transform the self-concepts of their followers" (Bass, Avolio, Jung, & Berson, 2003, p. 209) by acting as a role model. They also act as a coach and mentor, challenging subordinates to have higher expectations and set more difficult goals. These two major aspects of transformational leadership (role-modeling and goal-setting) were measured using the following two items:

3) To what extent does person [X] act as a role model to you in some way?
4) To what extent does person [X] help you set what *you* consider to be more difficult or higher goals for yourself?

By contrast, transactional leaders influence their followers by setting standards, monitoring performance, and offering rewards and punishment. Thus, two separate relationships – rewards and monitoring – were measured using the following items:

5) To what extent does person [X] recognize or reward your performance?
6) To what extent does person [X] monitor your performance or notice how you do your job?

Measurement. Each sociometric item was measured using a 3-point scale: *not at all* (0), *somewhat* (1), and *extensively* (2). Although the use of single-item measures may seem questionable on its face, such measures are common in network analysis, since typical sociometric items reflect relatively stable, easily identifiable relationships such as trust, friendship, advice, or communication. Past reviews suggest that such items possess adequate levels of reliability and validity (Zwijze-Koning & de Jong, 2005). For example, Ferligoj and Hlebec (1999) found that single-item measures of relationships such as social support and communication had reliability coefficients in the high .8's and validity coefficients in the high .9's.

Network construction. Although it is possible to analyze valued network data, the majority of social network methods (including random graph modeling, described below) are most easily applied to dichotomous ties. To facilitate analysis, the network data was therefore dichotomized. However, the ordinal nature of the original scale allowed for the creation of networks based on different thresholds for dichotomizing. Specifically, for each of the three primary networks being studied (overall, transformational, and transactional leadership), two networks were created.

One set of networks were formed based on only the strongest level of leadership relations reported. To construct these networks, each of the six component networks was dichotomized with matrix element $x_{ij} = 1$ if i reported an “extensive” relationship with j, and a 0 otherwise. Next, an aggregate matrix was formed based on the intersection of

these two component networks. For each of the three target networks (global leadership, transformational leadership, transactional leadership), elements of the matrix were defined such that a tie present in *both* of the component networks resulted in a tie present in the three combined networks. For example, if a person reported an extensive level of leadership *and* influence from another actor, then a tie between them was assigned in the global leadership network. If a person reported an extensive goal-setting relation with a given actor, but only a "somewhat" extensive role-modeling relation, then the combined transformational network would not contain a tie between the actors. The three combined networks based on this tie definition represent the strongest definition of leadership: all ties in the resulting networks are based on the existence of multiple "extensive" leadership relations.

Another set of networks was constructed on the basis of an alternative definition: instead of requiring that each component of the combined network contain an "extensive" tie, each component only had to contain at least a moderately-strong tie (e.g., "somewhat"). Using this definition, a dyad involving an extensive goal-setting relation but only a moderate role-modeling relation would still be assigned a tie in the aggregate transformational network. The networks based on this definition represent a slightly weaker and more relaxed definition of leadership. Thus, for each type of leadership, there was one network defined in two different ways – one representing "strong" leadership, and another representing "weak" leadership. A series of CFAs of the six leadership networks were conducted (Appendix B). Although they do not take into account the dependence introduced by the network structure, they do provide some

evidence that informal leadership ties may represent slightly different facets of a single general factor of influence.

Analyses

Exponential random graph models (ERGMs) were used to test for the hypothesized structural tendencies. Given a set of actors, the observed social network represents just one possible realization out of a huge number of possible networks[7]. For an observed network X with elements

$$x_{ij} = \begin{cases} 1 \text{ if } i \text{ has a relationship with } j, \\ 0 \text{ otherwise.} \end{cases}$$

we know that certain structural characteristics are more or less likely to occur by chance – for example, in a network where most actors are connected, even randomly, we would expect to see a relatively large number of transitive triads or reciprocal relations, simply by chance. Exponential random graph models (ERGMs) provide a way to test whether certain structural characteristics are more or less likely to occur by chance, given the observed network (Wasserman & Robins, 2005).

An exponential random graph model can be written in the following form

$$P(X = x) = \frac{1}{\kappa(\theta)} \exp\{\theta_i' z_i(x)\}$$

where $P(X = x)$ is the probability of a the observed graph X, κ is a normalizing constant, and θ is a vector of model parameters (similar to the β's of a standard regression equation) corresponding to $z(x)$, the vector of network statistics. These network

[7] In fact, a directed network with g actors has $2^{g(g-1)}$ possible states defining the sample space (Wasserman & Faust, 1994).

statistics $z(x)$ correspond to counts of the various network configurations. For example, the network statistic corresponding to reciprocity is given by the sum of the observed number of reciprocal dyads in the network, $\sum_{i,j} x_{ij} x_{ji}$. That number is then used to test whether reciprocity is a significant factor in the network.

Each model included a variety of structural parameters, as described in the hypotheses, as well as a number of parameters designed to control for the effects of individual differences on tie formation. This includes main effects associated with individual covariates such as geographic location and sex, as well as structural covariates associated with individual differences, such as homophily. Each model was fit by conditional MCMC-ML in SIENA (Snijders, Steglich, Schweinberger, & Huisman, 2007), which estimates model parameters conditional on the network density. Thus, no baseline density parameter is included in the model. Significance of each parameter was assessed using t-ratios (parameter estimate divided by the SE of the estimate); t-ratios greater than 1.96 were considered to be significant.

In order to assess model fit, observed numbers of graph configurations associated with each parameter (e.g., numbers of reciprocal dyads, transitive triads, etc.) were compared to the simulated distribution of such values based on model parameter estimates. Poor model fit is represented by observed value being extreme compared to the simulated distribution, while good model fit is represented by observed values close to the center of the simulated distribution. The observed values for each parameter can be converted to t-values based on the simulated distribution of scores. Large t-values represent observations that are extreme relative to the simulated distribution and poor fit,

and small t-values represent observations that fall in the center of the simulated distribution. Each model was run until the t-value associated with all of the observed parameters fell to .10 or below.

Parameters can be interpreted in terms of the probability of the observed network, such that positive parameters indicate a network with that feature is more likely to be observed. These numbers can also be interpreted as log-odds. For example, a random graph model with a parameter value of .84 means that ties are 2.32 times more likely to be reciprocated than not reciprocated, since $exp(.84) = 2.32$. Each parameter is estimated conditional on the other parameters in the model, and must be interpreted conditional on other model effects; for example, a model with significant positive levels of both reciprocity and sex homophily would indicate that there is a significant tendency for people to reciprocate ties, taking into account the effects of tie formation based on dyadic similarities in sex.

RESULTS

Table 1 provides an overview of several key structural characteristics for each of the four target networks, broken down by the method used to define the dichotomous adjacency matrix (e.g., whether a "weak" or "strong" definition of ties were used). Statistics for the organization's friendship network are provided for the sake of comparison with the leadership network. The descriptive statistics show that the networks are very sparse, with most densities well below .10, and that the leadership networks tend to be significantly sparser than the equivalently defined friendship network ($p < .01$).

The table also suggests that the networks are not extremely centralized[8], indicating that there does not tend to be a great amount of variability in the extent to which members of the organization send or receive ties, compared to the maximum possible variability that might be observed in a graph of this size. The statistics indicate that the leadership networks are roughly equivalent in terms of centralization, with most centralization indices falling between 0.20 and 0.35; however, the centralization of incoming "strong" transactional leadership ties were particularly low (centralization = 0.17), indicating that most people tended to be monitored and rewarded "extensively" by roughly similar numbers of other actors. Also of note, friendship outdegrees appeared to be moderately centralized (0.45 and 0.38). This indicates a substantial degree of dispersion in the rates at which actors nominated others as friends.

[8] Centralization indices range from 0 to 1, and can be used to represent the degree of dispersion or inequality of the individual centralities (Wasserman & Faust, 1994). That is, the higher the centralization index, the more the network is dominated by a few well-connected actors; the lower the centralization score, the more the network will tend to have actors with relatively similar numbers of connections.

Table 1
Network descriptive statistics

Network	Hierarchy	Efficiency	Connectedness	Indegree Centralization	Outdegree Centralization	Density
Weak definition						
Leadership	0.12	0.93	0.96	0.32	0.29	0.07**
Transformational	0.10	0.94	0.93	0.32	0.30	0.06**
Transactional	0.08	0.96	0.92	0.33	0.35	0.05**
Friendship	0.17	0.84	1.00	0.24	0.45	0.16
Strong definition						
Leadership	0.05	0.98	0.81	0.24	0.30	0.02**
Transformational	0.04	0.98	0.79	0.21	0.29	0.02**
Transactional	0.04	0.98	0.67	0.17	0.27	0.02**
Friendship	0.08	0.95	0.99	0.09	0.38	0.05

** Compared to density of equivalently defined friendship network, $p < .01$.

The other descriptive statistics provided in Table 1 were proposed by Krackhardt (1994) as indicators of a network's level of hierarchical structure. *Connectedness* represents the proportion of actors that can be reached by others in the network – fully connected networks will have a score of 1, and unconnected networks (ones with no ties) will have a score of 0. The scores indicate that the networks were relatively well-connected. In this organization, the least well-connected network was transactional leadership (connectedness = 0.67 for strongly-defined ties). These numbers indicate that most people were connected in some way to the leadership structure of the organization.

The other graph statistics – hierarchy and efficiency – represent 1) the proportion of non-null dyads that are asymmetrical, and 2) the extent to which graph components are minimally connected[9]. Numbers may range from 0 to 1. The statistics indicate that the organizational networks apparently tend towards more reciprocal relations, and that the network tends to be relatively efficient.

To further visualize the shape of the network, Figure 6 provides a series of plots showing the distribution of actor in-degrees (leadership nominations received) and out-degrees (leadership nominations made) across each of the three types of leadership networks[10]. Each plot shows the distribution of degree scores for a given network based on a "strong" and a "relaxed" (or weak) definition of adjacency. Strong networks appeared to have fewer high-degree actors and more very low-degree actors, but roughly similar distributional forms. Figure 7 provides a slightly different view of the data,

[9] Efficiency provides information about redundancies in the network – if actors tend to be connected by several different paths simultaneously, efficiency scores will be low.
[10] These represent unnormalized degree centralities.

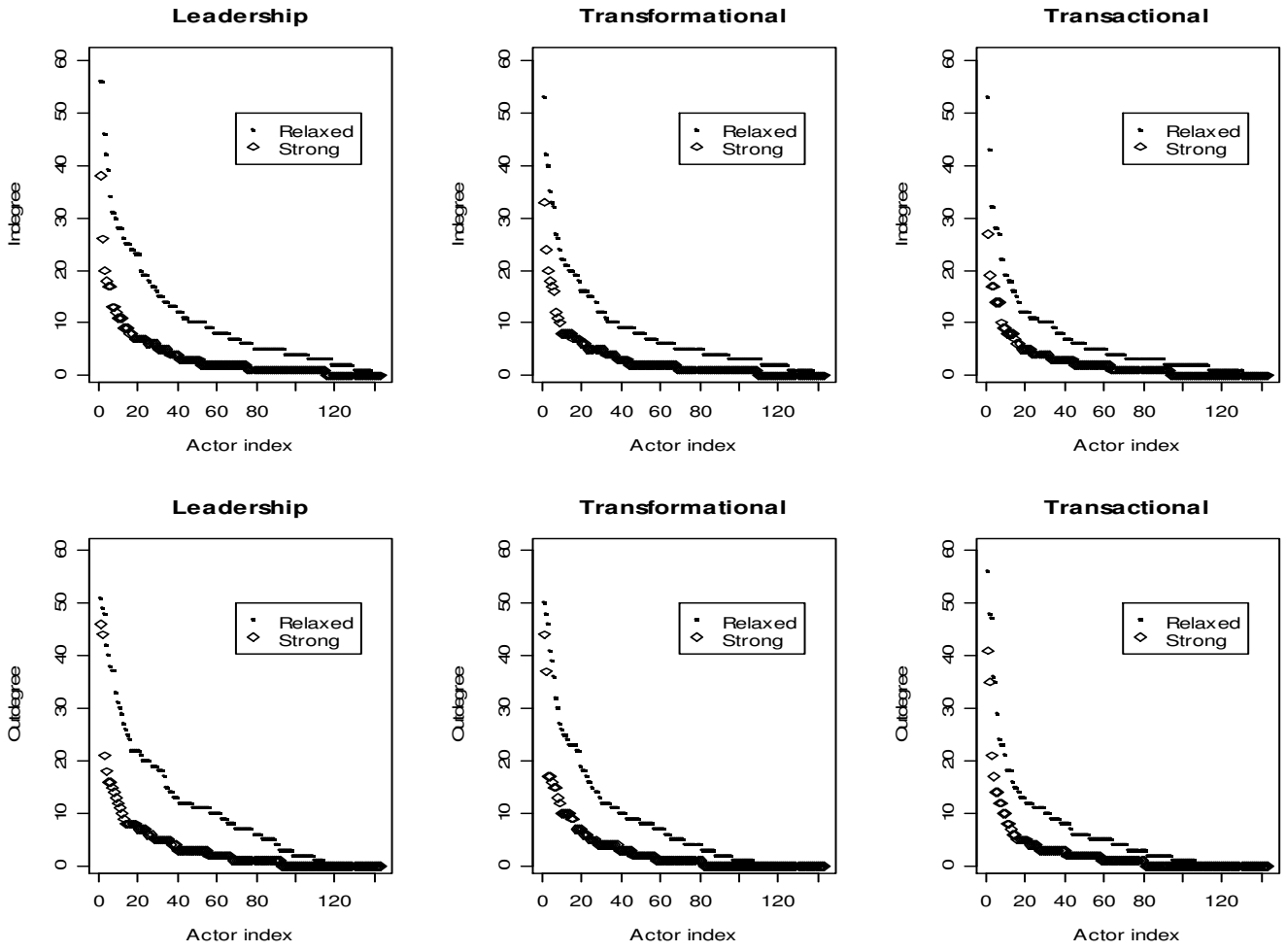


Figure 6. Degree distributions (in- and out-degree) for leadership networks.

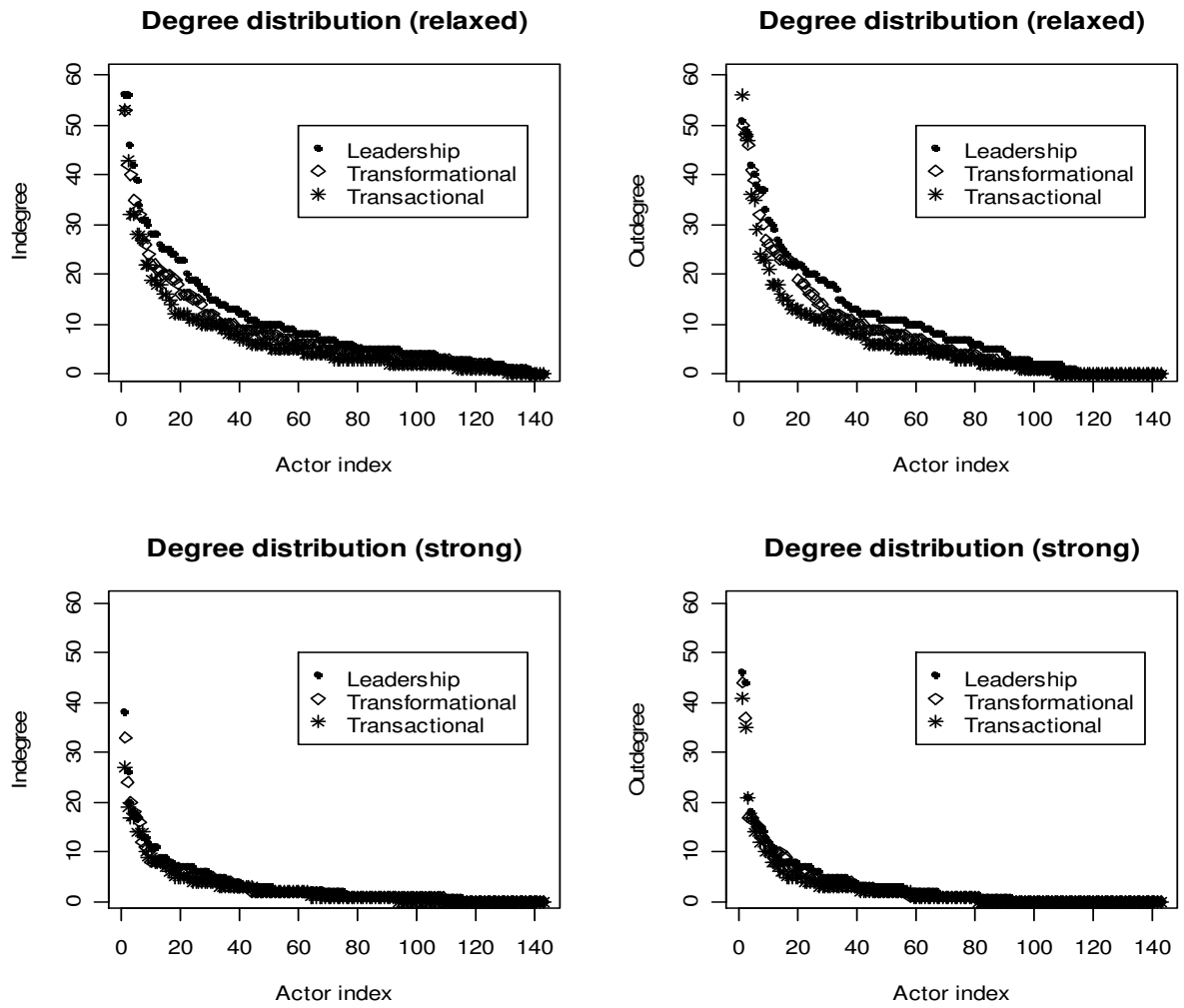


Figure 7. Comparative leadership network degree distributions.

Table 2
Component network QAP correlations[11]

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Weak														
1.	Leadership													
2.	Influence	.77												
3.	Role	.81	.77											
4.	Goal	.78	.73	.78										
5.	Reward	.69	.66	.69	.71									
6.	Monitor	.68	.65	.63	.68	.70								
7.	Friendship	.55	.63	.58	.53	.51	.48							
Strong														
8.	Leadership	.60	.51	.57	.59	.55	.54	.36						
9.	Influence	.53	.56	.54	.55	.53	.52	.39	.74					
10	Role	.56	.50	.59	.59	.54	.50	.36	.78	.72				
11.	Goal	.54	.48	.53	.61	.54	.52	.33	.74	.67	.76			
12.	Reward	.49	.45	.49	.54	.61	.52	.33	.68	.62	.68	.70		
13.	Monitor	.53	.47	.48	.53	.57	.64	.34	.65	.62	.60	.66	.70	
14.	Friendship	.41	.46	.45	.43	.42	.33	.55	.42	.47	.44	.40	.43	.37

[11] All correlations are significant at $p < .01$.

Table 3
Aggregate network QAP correlations[12]

		1.	2.	3.	4.	5.	6.	7.
Weak								
1.	Global leadership							
2.	Transformational	0.81						
3.	Transactional	0.66	0.69					
4.	Friendship	0.54	0.50	0.44				
Strong								
5.	Global leadership	0.62	0.62	0.59	0.36			
6.	Transformational	0.52	0.59	0.54	0.30	0.75		
7.	Transactional	0.47	0.51	0.62	0.29	0.66	0.71	
8.	Friendship	0.42	0.44	0.35	0.55	0.42	0.40	0.39

[12] All correlations are significant at $p < .01$.

comparing the shape of degree distributions for each of the three networks more directly. As shown in Figure 7, each of the three leadership networks had very similar degree distributions, with somewhat higher degrees for global leadership than transactional leadership in weak leadership networks.

Another important aspect of the organizational networks is the degree to which they overlap. Table 2 presents QAP correlations between each of the seven original component networks used to form the aggregate networks used in other analyses. There were significant and substantial correlations between each of the networks, with some of the highest correlations between the role-setting, goal-setting, and leadership networks. There also appeared to be slightly lower correlations between networks formed using "strong" criteria. Table 3 presents QAP correlations for the aggregate networks. Again, there were fairly substantial correlations between global leadership ties and transformational leadership ties. Friendship ties also correlated significantly with each of the three types of leadership relations, although leadership relations tended to correlate more strongly with one another than with friendship.

To get a better picture of the network, Figures 8-15 provide pictures of each of the four organizational networks using both strong and weak tie definitions. The size of the network can make it difficult to see specific features clearly, so Figure 16 provides a vector-based graphic that demonstrates the general pattern of ties that may be observed within each network. Specifically, Figure 16 shows what appear to be two large components, each with their own associated cores, peripheries, and local clusters.

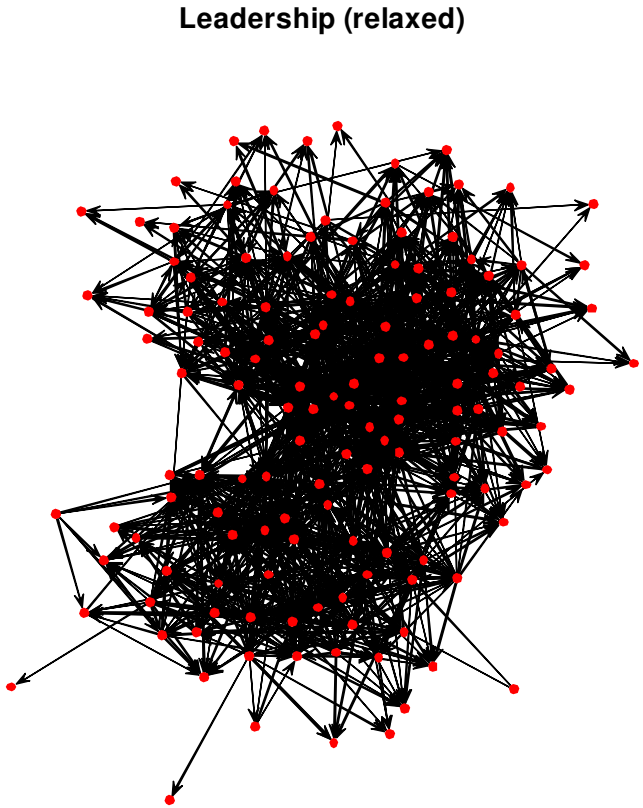


Figure 8. Leadership network, based on weak definition of adjacency.

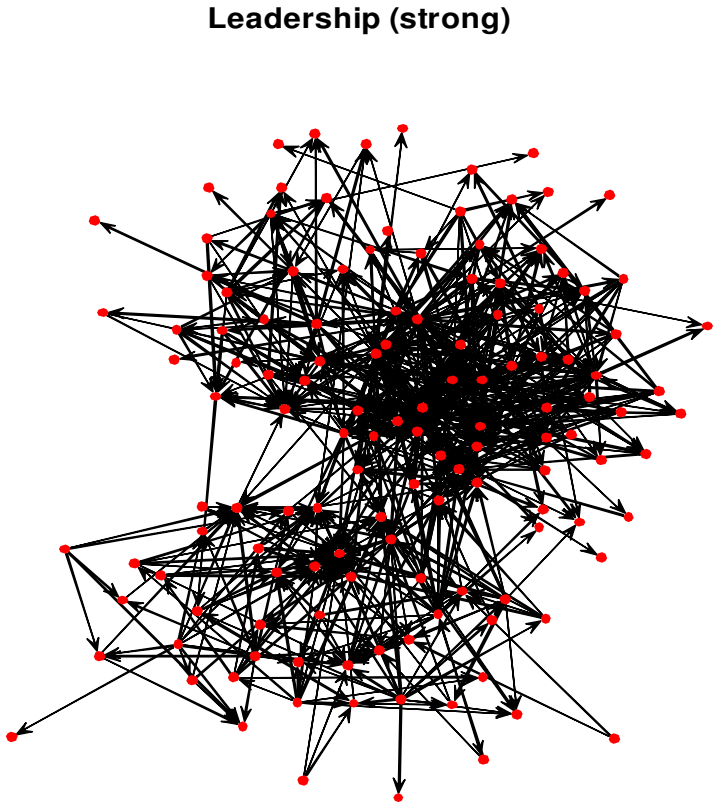


Figure 9. Leadership network, based on strong definition of adjacency.

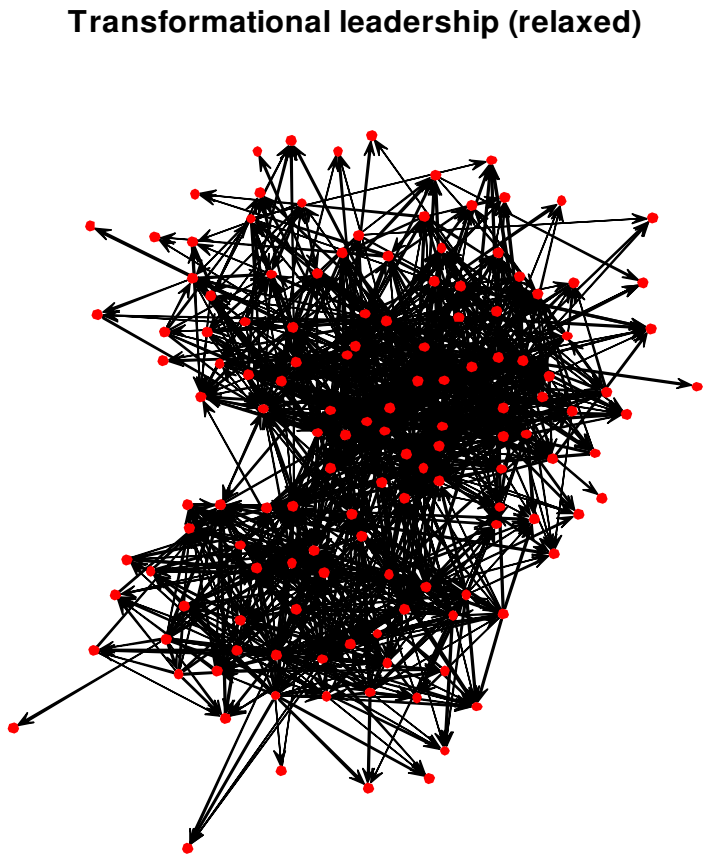


Figure 10. Transformational leadership network, based on weak definition of adjacency.

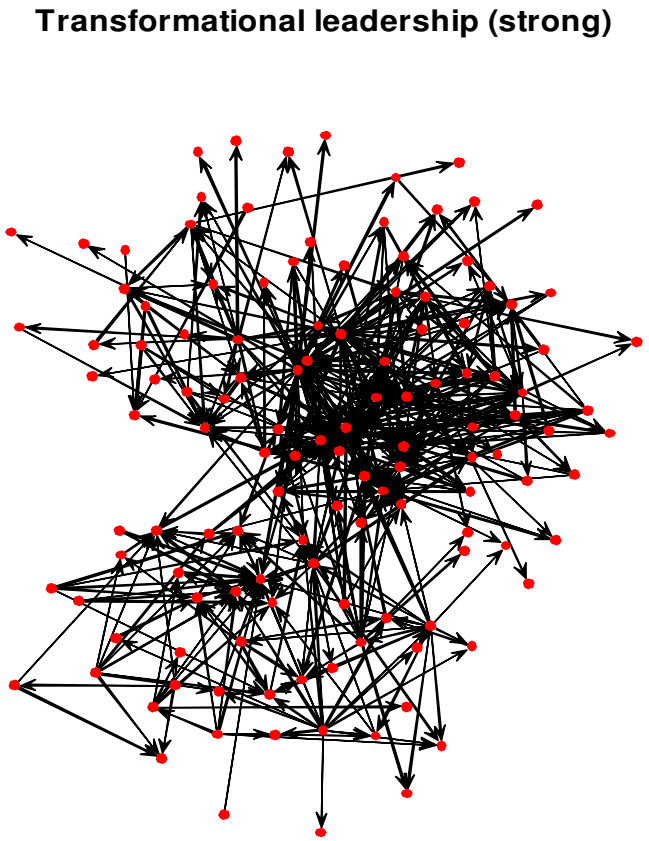


Figure 11. Transformational leadership network, based on strong definition of adjacency.

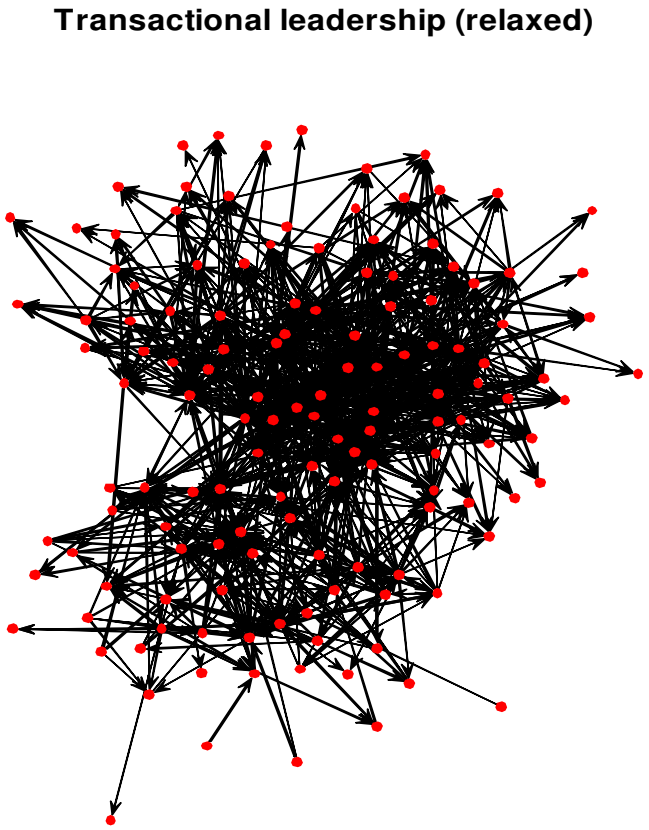


Figure 12. Transactional leadership network based on weak definition of adjacency.

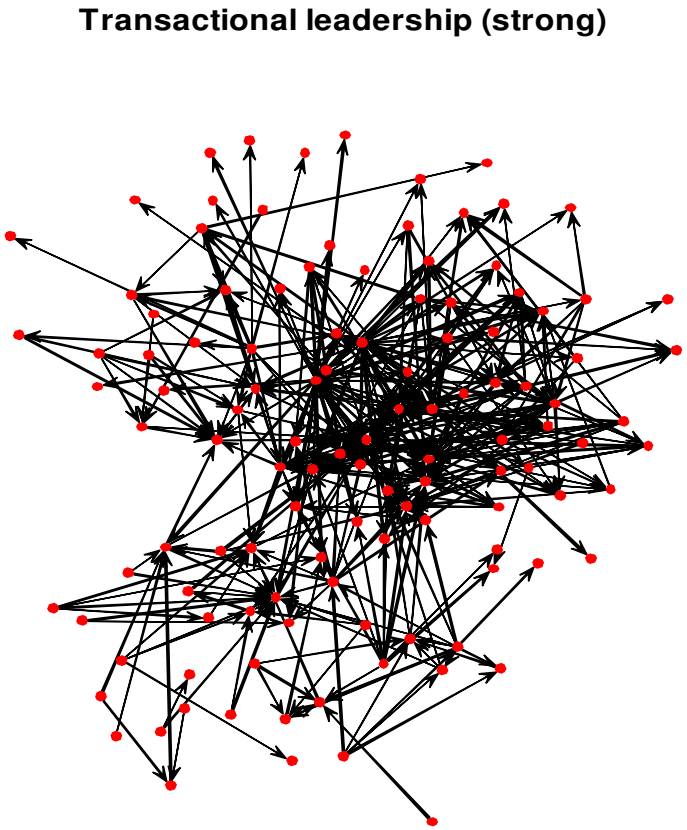


Figure 13. Transactional leadership network based on strong definition of adjacency.

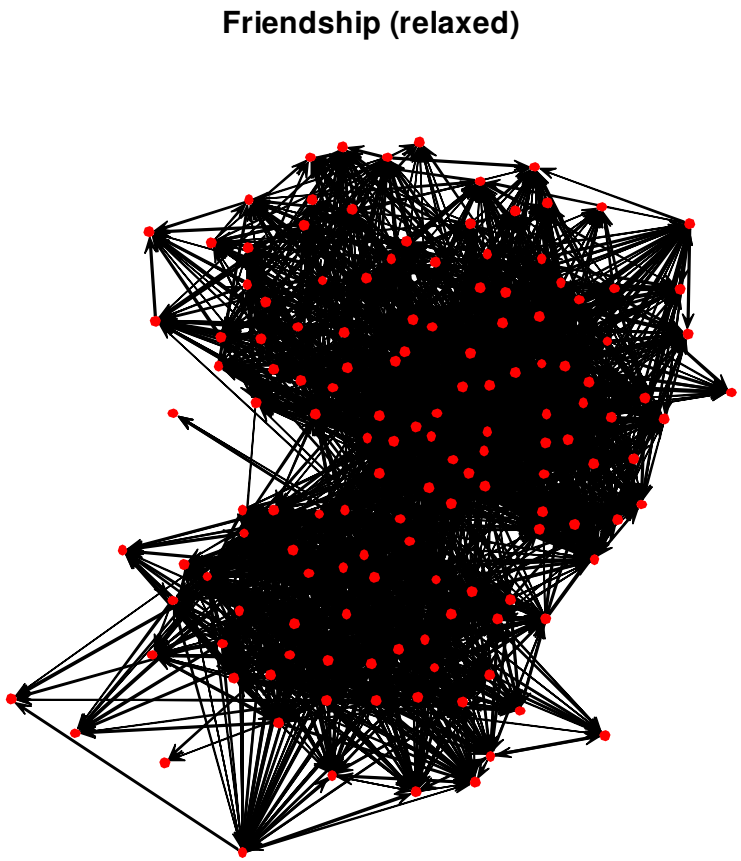


Figure 14. Friendship network based on weak definition of adjacency.

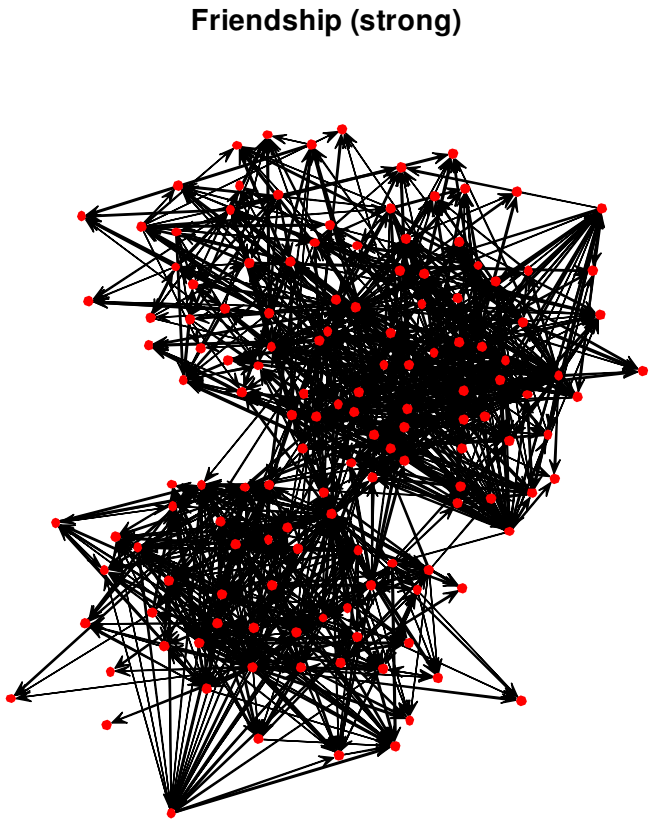


Figure 15. Friendship network based on strong definition of adjacency.

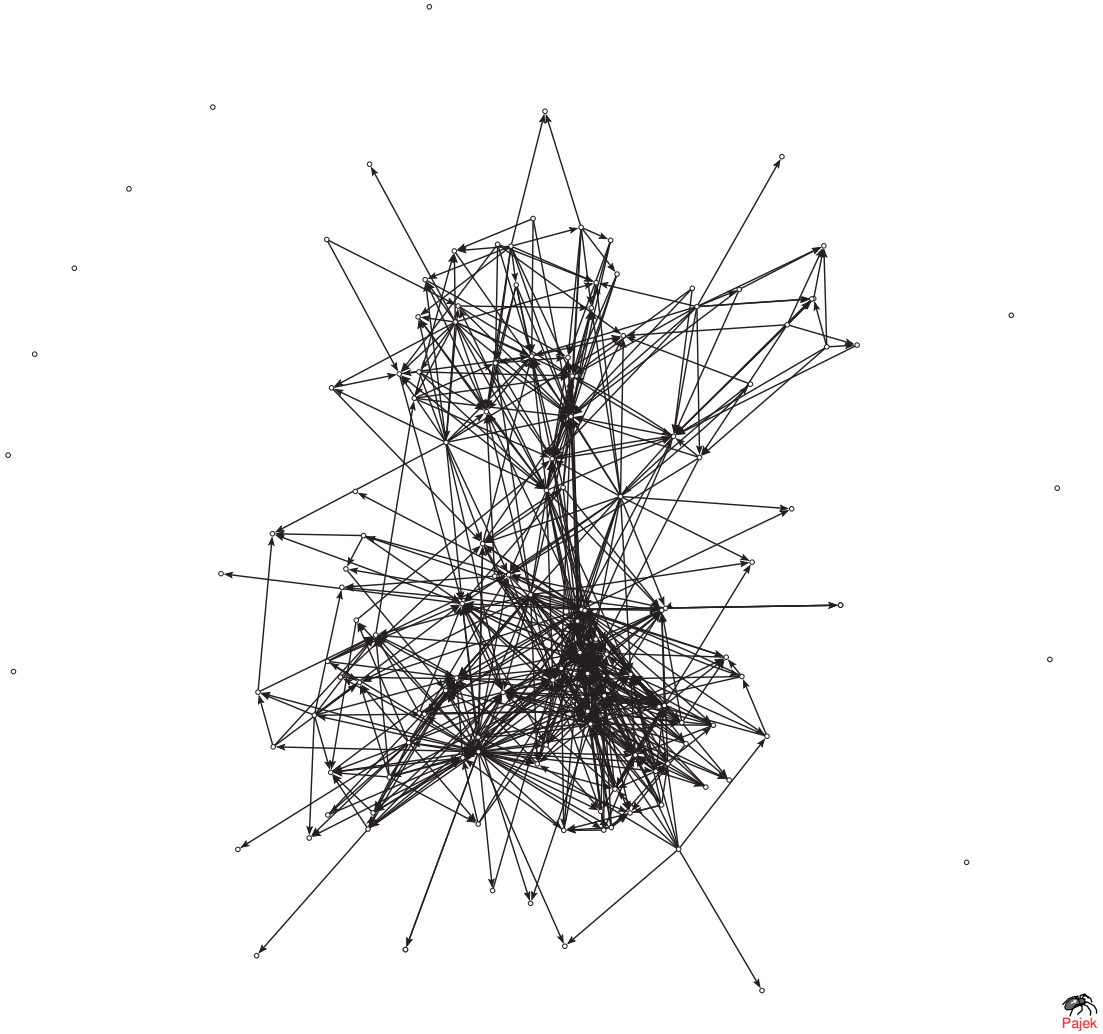


Figure 16. Example network layout showing leadership relations based on a strong definition of adjacency.

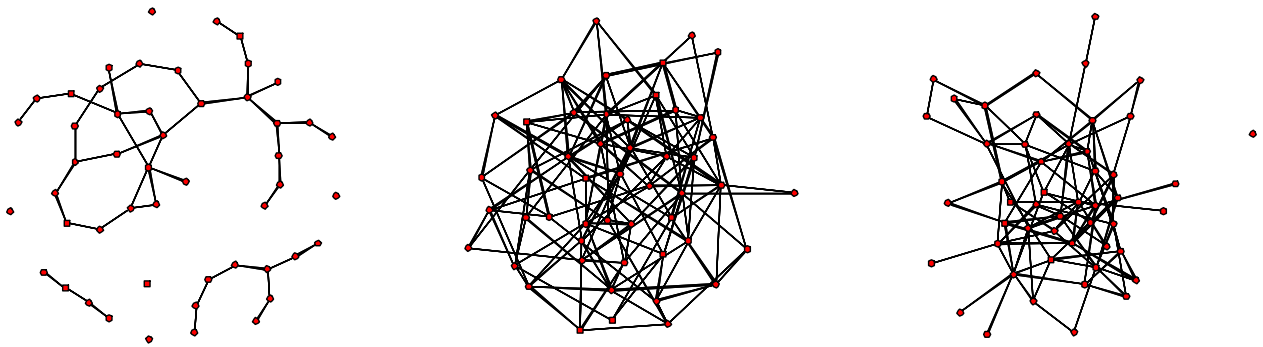


Figure 17. Example graphs with k-star parameters (from left to right) of -0.8, 0, and 0.8 showing the shift from a segmented to a centralized structure.

Global leadership network

General interpretations of the model parameters being tested are shown in Table 4a. Table 4b shows the estimated model parameters for each of the six aggregate leadership networks used in the analyses, represented by Models I-VI, and Table 4c provides the odds ratios associated with each parameter. Table 5 provides an overview of the tendency (positive, negative, or null) for different types of structures. Hypotheses 1-5 refer to structures in the global leadership structure (i.e., not specific to a particular type of leadership), and are tested in Models I and II. Model I describes the structure of the global leadership network based on a weaker definition of leadership and influence, while Model II is based on a stronger definition.

The first hypothesis (H1) was that a global (or overall) emergent leadership network should display tendencies for some actors to receive multiple ties – specifically, that some actors should be much more prominent in the leadership and influence network than others. This hypothesis is tested by the "in-k-star" parameter, shown in Table 4b. A positive k-star parameter represents a tendency for high levels of variance in the degrees (number of ties) associated with actors in the network, core-periphery structures based on degrees, and preferential attachment[13]; a negative in-star parameter suggests that degree distributions in the observed graph are less dispersed, with most actors tending to have smaller, more moderate numbers of connections, and relatively few actors having very high large numbers of connections. Figure 17 provides some

[13] Preferential attachment refers to the tendency for low-degree actors to form attachments to higher-degree actors, which is sometimes described as a "rich gets richer" effect.

Table 4a
Interpretation of ERGM parameters

Structural characteristics	Interpretation
Reciprocal dyads	Reciprocity
Alternating out-k-stars	Variance in out-stars, with greater weight attached to lower-order stars. Out-degree centralization. Models the out-degree distribution.
Alternating in-k-stars	Variance in in-stars, with greater weight attached to lower-order stars. In-degree centralization. Models the in-degree distribution.
Alternating 2-paths	Higher-order term representing indirect connections. Tendency for a set of actors to share multiple short indirect connections through third parties.
Alternating k-triangles	Higher-order transitivity term. Tendency for transitive triads to form, especially in groups.
3-cycles	Generalized exchange
Homophily effects	
Location	Likelihood of sharing a tie if two actors share a physical location.
Sex	Likelihood of sharing a tie if two actors have the same sex.
Supervisor status	Likelihood of sharing a tie if two actors are both supervisors.
Tenure	Likelihood of sharing a tie if two actors have more similar tenure in the organization.
Attribute ego effects	
Sex	Main effect of sex on the number of leader nominations made.
Supervisor status	Main effect of supervisor status on the number of leader nominations made.
Tenure	Main effect of tenure on the number of leader nominations made.
Attribute alter effects	
Sex	Main effect of sex on the number of leader nominations received.
Supervisor status	Main effect of supervisor status on the number of leader nominations received.
Tenure	Main effect of tenure on the number of leader nominations received.

Table 4b

Exponential random graph models of emergent organizational leadership networks

	Global (overall) leadership		Transformational		Transactional	
	Weak (I)	Strong (II)	Weak (III)	Strong (IV)	Weak (V)	Strong (VI)
Structural characteristics						
Reciprocal dyads	.84 (.17)**	.32 (.64)	.91 (.21)**	-1.87(1.29)	1.34 (.22)**	.07 (.78)
Alternating out-k-stars	.34 (.10)**	.86 (.11)**	.62 (.10)**	1.05 (.11)**	.80 (.10)**	1.02 (.11)**
Alternating in-k-stars	- .76 (.15)**	.17 (.13)	- .63 (.15)**	.19 (.13)	- .03 (.12)	.47 (.12)**
Alternating 2-paths	- .15 (.01)**	- .29 (.03)**	- .18 (.01)**	- .30 (.03)**	- .17 (.01)**	- .23 (.03)**
Alternating k-triangles	1.25 (.05)**	1.09 (.06)**	1.19 (.04)**	1.13 (.07)**	1.03 (.05)**	1.03 (.08)**
3-cycles	- .26 (.04)**	-1.64 (.74)**	- .40 (.07)**	-1.11 (1.05)	- .34 (.07)**	-1.76 (1.05)
Homophily effects						
Location	.31 (.03)**	.74 (.09)**	.32 (.04)**	.76 (.10)**	.36 (.05)**	.72 (.10)**
Sex[14]	.23 (.04)**	.12 (.09)	.26 (.05)**	.17 (.10)	.22 (.07)**	.11 (.11)
Supervisor status[15]	- .01 (.05)	.02 (.11)	.00 (.07)	- .06 (.11)	- .19 (.08)**	- .12 (.12)
Tenure	.24 (.10)**	.20 (.23)	.12 (.13)	.14 (.25)	.35 (.15)**	.35 (.27)
Attribute ego effects						
Sex	- .13 (.02)**	- .31 (.06)**	- .14 (.03)**	- .24 (.06)**	- .13 (.04)**	- .21 (.06)**
Supervisor status	- .05 (.03)	.01 (.07)	- .05 (.03)	.06 (.07)	.01 (.04)	.08 (.07)
Tenure	- .04 (.02)**	- .03 (.04)	- .01 (.02)	- .02 (.04)	- .05 (.03)	- .06 (.05)
Attribute alter effects						
Sex	- .14 (.02)**	- .32 (.06)**	- .16 (.03)**	- .31 (.07)**	- .16 (.03)**	- .24 (.07)**
Supervisor status	.06 (.02)**	.19 (.07)**	.06 (.03)	.23 (.08)**	.08 (.04)*	.25 (.08)**
Tenure	.04 (.02)*	.11 (.04)**	.06 (.02)**	.12 (.05)**	.04 (.02)	.09 (.05)*

[14] Sex was coded M=0, F=1.

[15] Supervisor status was coded No=0, Yes=1.

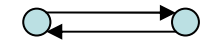
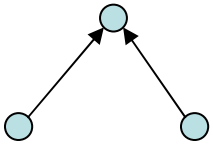
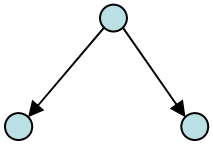
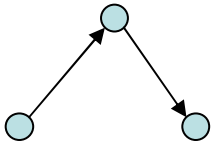
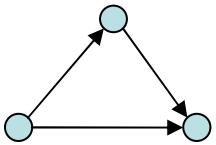
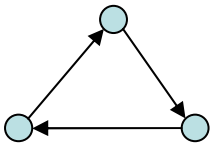
* p < .05, ** p < .01). Standard errors are in parentheses.

Table 4c
Odds ratios associated with each parameter

	Global (overall) leadership		Transformational		Transactional	
	Weak (I)	Strong (II)	Weak (III)	Strong (IV)	Weak (V)	Strong (VI)
Structural characteristics						
Reciprocal dyads	2.13**	1.38	2.48**	.153	.82**	1.07
Alternating out-k-stars	1.40**	2.36**	1.86**	2.86**	2.22**	2.77**
Alternating in-k-stars	.47**	1.19	.53**	1.21	.97	1.60**
Alternating 2-paths	.86**	.75**	.83**	.74**	.84**	.79**
Alternating k-triangles	3.49**	2.97**	3.29**	3.10**	2.80**	2.80**
3-cycles	.77**	.19**	.67**	.33	.71**	.17
Homophily effects						
Location	1.36**	2.10**	1.38**	2.14**	1.43**	2.05**
Sex[16]	1.26**	1.13	1.30**	1.18	1.24**	1.11
Supervisor status[17]	.99	.98	1	.94	.83**	.89
Tenure	1.27**	1.22	1.13	1.15	1.42**	1.42
Attribute ego effects						
Sex	.88**	.73**	.87**	.79**	.88**	.81**
Supervisor status	.95	.99	.95	1.06	.99	1.08
Tenure	.96**	.97	.99	.98	.95	.94
Attribute alter effects						
Sex	.87**	.73**	.85**	.73**	.85**	.79**
Supervisor status	1.06**	1.21**	1.06	1.26**	1.08*	1.28**
Tenure	1.04*	1.12**	1.06**	1.13**	1.04	1.09*

[16] Sex was coded M=0, F=1.
[17] Supervisor status was coded No=0, Yes=1.
* p < .05, ** p < .01). Standard errors are in parentheses.

Table 5
Overview of evidence for various structural configurations[18]

	Global (overall) leadership		Transformational leadership		Transactional leadership	
	Strong	Weak	Strong	Weak	Strong	Weak
	0	+	0	+	0	+
	0	-	0	-	+	0
	+	+	+	+	+	+
	-	-	-	-	-	-
	+	+	+	+	+	+
	-	-	0	-	0	-

[18] Positive tendencies for structural configurations are represented with a '+', negative tendencies with a '-'. Structural parameters not significantly different from zero are marked with a 0.

example graphs for different k-star parameters, showing how graphs with various positive and negative k-star coefficients tend to appear.

As shown in Model I, the in-star parameter is slightly negative. This indicates that most actors are not likely to receive an especially large number of global leadership nominations, and that there is slightly less variance in each actor's nominations as a leader than we would expect to see by chance, taking into account other effects in the model, such as transitivity. In the strong network of global leadership nominations (Model II), this effect is positive, but not significantly different from zero; this implies there is no significant tendency for high or low variance in the leadership nominations received by actors conditional on other effects in the model. Thus, Hypothesis 1 was not generally supported; in fact, for weak leadership networks, the results indicate a slight preference for attachment to actors with *fewer* leadership nominations, conditional on other model effects; and no significant tendency for preferential attachment or in-degree-based core-periphery structures for strong leadership relations.

The second major type of structural feature expected to define networks of global (or overall) emergent leadership was transitivity (H2). As shown in Table 4b (Models I and II), there were strong tendencies for actors to engage in overlapping transitive leadership structures. These transitive k-triangles may occur because of both real pressures for transitive triangles (e.g., competition resulting in partially ordered hierarchies), as well as by chance (e.g., a combination of homophily, degree distributions, k-paths, and random ties); however, the inclusion of these parameters in the model controls for these alternative explanations, indicating that the high levels of

transitive triangles observed in the model are due to actual transitivity effects, not a combination of other factors.

These transitive triangles tend to occur in overlapping clusters, which suggests that core-periphery structures in the network tend to be based on transitivity, not degrees. Moreover, the strong positive transitivity effect, combined with the weak in-star effect suggests that high-degree actors tend to have high degrees because of their participation in complex transitive clusters, *not* because they are the center of many independent leadership nominations (e.g., in-star parameters). Because there is a negative 2-path effect, the positive k-triangle effect suggests some pressure for clique-like structures in the organization (Snijders et al., 2006), where individuals who receive many leadership nominations are more likely to do so within dense clusters. Overall, Hypothesis 2 was strongly supported.

The third hypothesis (H3) suggested that leadership networks should display significant levels of clustering, representing the tendency for coalition formation, based on transitive *k*-triangles and negative independent *k*-paths. The parameter tests indicate that Hypothesis 3 was strongly supported for both relaxed and strong definitions of leadership (Model I and II).

According to the fourth hypothesis (H4), overall emergent leadership nominations should display significant tendencies towards reciprocity. For moderately strong leadership networks, the random graph analyses indicate a strong positive tendency for individuals to reciprocate leadership nominations (see Model I in Table 4b): in other words, compared to a random network with similar levels of homophily,

clustering, density, and other effects, there is a greater tendency to reciprocate leadership nominations[19].

However, this tendency towards reciprocity is no longer significant for leadership nominations based on a higher threshold (Model II). This implies that for strong emergent leadership relations, there are no more and no fewer reciprocal dyads than would be expected by chance, conditional on the other model parameters. Thus, Hypothesis 4 was supported for weak leadership networks, but rejected for leadership networks based on the strongest levels of emergent leadership perceptions.

The final hypothesis (H5) involving global leadership networks suggested that pressures for coalition building would result in a positive tendency to engage in generalized exchange relationships. This was tested in Models I and IV using cyclic configurations of order 3 ("3-cycles"). The results show that once effects due to homophily, reciprocity, and transitivity are taken into account, 3-cycles are extremely unlikely. This indicates that to the extent leadership coalitions or subgroups exist, they are more likely to involve dyadic effects such as reciprocity and homophily, not generalized exchange.

Transformational and transactional leadership networks

Table 4 also presents model parameters related to Hypotheses 6 and 7, involving comparisons between transformational and transactional leadership networks. Random graph parameters associated with weak transformational and transactional relations are

[19] Note that this does *not* mean that most leadership nominations are actually reciprocated – it merely means that, conditional on other structural effects, there is more reciprocity than we would expect to see by chance.

shown in Models III and V, respectively, while parameters associated with strong relationships are shown in Models IV and VI. To compare structural effects, confidence intervals were calculated for each structural effect. Comparing 95% CIs for parameter estimates provides an extremely conservative test of the difference between the two.

A simulation study by Peyton, Greenstone, and Schenker (2003) found that when ratios of parameter standard errors are below 2, 84% CIs will overlap 95% of the time. Therefore, 84% CI were estimated for parameter estimates in transformational and transactional leadership networks. Overlapping CIs mean that parameter estimates are not significantly different from one another ($p > .05$). In the case of reciprocity (H6), confidence intervals consistently overlapped; thus, H6 was not supported. Similarly, in the case of strong networks, there was substantial overlap in estimates of transitivity. However, in the case of moderately strong networks, estimates of transitivity did not overlap (upper and lower estimates of [1.13, 1.25] and [.97, 1.09] for transformational and transactional networks, respectively). These results provide partial support for H7, which suggested that transformational networks are more likely than transactional ties to involve transitive and reciprocal structures.

However, the model also indicates that these two types of leadership networks differed in ways not predicted: for example, moderately strong transformational leadership networks displayed significantly lower levels of in-degree centralization than transactional networks. This indicates that the number of transactional leadership nominations received by actors in the network were significantly more variable than the number of transformational leadership nominations.

These results suggest that hierarchies within the two leadership networks tend to take slightly different forms, with actors in the transformational leadership network being prominent by their participation in transitive clusters and reciprocal dyads, and displaying a tendency to avoid preferential attachment (e.g., forming ties with more prominent leaders). By contrast, the transactional network appeared to have a much more substantial bias towards in-degree centralization and away from transitivity. This indicates that compared to transformational leaders, prominent transactional leaders are slightly more likely to be at the center of degree-based structures such as stars, especially by being connected to lower-degree (less prominent) leaders.

Attributes and emergent leadership structures

Individual attributes were primarily included as controls for the random graph analyses; however, they highlight a number of important relational tendencies in the various emergent leadership networks. In Table 4b, these effects are listed under the headings *homophily effects*, *attribute ego effects*, and *attribute alter effects*.

Homophily effects refer to the tendency for people to form ties with others who share similar levels of an attribute. As shown in Table 4b, there were significant levels of homophily in each of the leadership networks. As might be expected from previous research on proximity, location proved to be a consistent predictor of leadership nominations across all networks, such that individuals were much more likely to nominate leaders within their own particular business location. However, this effect was weaker for more “relaxed” network definitions, suggesting that the weak leadership ties are more likely than strong leadership ties to form across different locations.

There were also significant homophily effects related to sex, supervisor status, and tenure in several of the weak networks (e.g., Models I, III, and V). Interestingly, there was no evidence of homophily in strong leadership networks outside of the effect of location. This may indicate that weaker leadership relations are more subject to the effects of homophily than strong ties.

The rest of the parameters in Table 4b refer to the effect that individual attributes have on the number of leadership nominations made (ego effects) and received (alter effects). Across all networks (Models I-VI), sex appears to have significant effects on the likelihood of being selected as a leader as well as identifying others as a leader. Specifically, women were less likely to nominate others as leaders and to be nominated. Supervisor status was also a significant factor in several of the networks; supervisors were more likely to be the recipient of leadership nominations, especially in "strong" leadership networks, and were slightly less likely to ascribe transactional leadership status to other supervisors ($B = -.19$, $p < .01$) in moderately strong networks. Finally, there were several main effects related to tenure, such that individuals who had been with the organization longer were more likely to be nominated as leaders. In the weak overall leadership networks (e.g., Model I), those who had been with the organization longer made fewer leadership nominations.

DISCUSSION

Results from the study highlight the complex nature of informal leadership and influence structures in organizations. Although perceptions of leadership and influence are clearly related to individual attributes such as sex and formal status in the organization, these networks also display a variety of relational tendencies that go beyond individual and dyadic-level effects. Just as importantly, these effects appear to differ to some degree by the type of leadership relationship perceived by actors.

Overall, the study found that support for the hypotheses tended to depend on the strength of the leadership network, with some exceptions. There was strong support for Hypothesis 2 (transitivity) and substantial support for Hypothesis 3 (multiple clusters of transitive ties), and no support for Hypotheses 1 (degree-based centralization), 5 (generalized exchange), or 6 (differences in reciprocity across transformational and transactional leadership networks). There was partial support for Hypotheses 4 (reciprocity) and 7 (differences in transitivity between transformational and transactional leadership networks).

Structural interpretations

Beyond the specific hypothesis tests, the results highlight the interdependent nature of leadership and influence. The parameters in Table 4 reveal a variety of complex patterns at multiple levels of analysis. Some of these patterns were expected, but a surprising number were not, and the combination of factors provides a great deal of information on the nature of leadership and influence within the sample organization.

The overall picture of leadership painted by the model is a structure where relationships form on the basis of both individual demographics a few fundamental structural features that reflect simultaneous pressures for both centralization and decentralization. For example, strong leadership relations appear to be based on shared physical location, sex differences in the propensity to send leadership nominations, as well as differences in the tendency to receive nominations associated with sex, supervisor status, and tenure.

Conditional on these effects, there is strong tendency for the formation of multiple cores of overlapping transitive triangles (positive *k*-triangles and negative independent *k*-paths), for little variability in leadership in-degrees outside of these transitive cores (*n.s.* in-star parameter in the presence of *k*-triangle and *k*-path parameters), and for some followers outside of the transitive cores to nominate multiple leaders (positive out-stars in the presence of *k*-triangle and *k*-path parameters). That is, prominent leaders appear to receive nominations from followers who attract followers themselves, not from independent actors; and that this process tends to occur within slightly separated leadership clusters. It also suggests that there may be some unmeasured factor that prevents high-degree leaders from existing outside of tightly-knit clusters of transitive leadership relations, such as department membership or inter-office location. Finally, there is a strong tendency not to engage in generalized exchange relationships.

The weak overall leadership network displays many of these same characteristics: there is an even stronger tendency for cliquish behavior based on

transitive triangles (positive *k*-triangles and negative independent *k*-paths) but not generalized exchange. Popular leaders tend to be popular within these transitive cliques (indicated by the negative in-star parameter in the presence of a positive transitivity effect), not outside of them; this result may reflect the existence of favored in-groups and the differential development of relationships between leaders and various followers, which is predicted by theories such as LMX (Sparrowe & Liden, 1997), and there is substantial variability in the number of leadership nominations made by individuals outside of these cliques (positive out-star parameter).

Interestingly, there is a strong tendency to reciprocate ties in the weak leadership network which is not present in the strong network, suggesting that stronger leadership and influence networks tend to be slightly more hierarchical. There is also a weaker effect of location homophily in the weak overall leadership network, and weaker ties may be more likely to form outside of specific geographical locations, consistent with the Granovetter's concept of the strength of weak ties (Granovetter, 1973) that form bridges between cohesive cliques.

Transformational leadership ties tended to follow very similar patterns to global leadership ties, but transactional networks appeared to be substantially more hierarchical in the traditional sense: compared to the other networks, the in-star parameters were more positive, especially in the strong transactional network. This suggests a significant level of degree-based centralization occurring outside of the more cliquish transitive structures, and a core-periphery structure at least partly based on star-like structures instead of overlapping triangles, in the case of transactional leadership.

Findings and implications

One of the more interesting findings was that structural predictors of the emergent leadership network were at least as powerful as explanations based on individual demographics and formal power (which have been the most-studied factors in traditional emergent leadership research), and these structural effects were highly significant even after taking the individual-level effects into account. For example, in a geographically dispersed network, we might expect to see multiple core-periphery structures and significant levels of clustering, but the analysis shows that pressures for transitive clusters are even stronger than (and cannot be explained by) the effects of shared location on leadership tie formation. Similarly, there is also a very strong tendency for reciprocity in weak leadership networks which cannot be explained by sex, tenure, supervisory position, or location.

The implication for research on shared leadership is that *weak leadership* is shared reciprocally between members of the organization, while *strong leadership* is not shared. This means that it is not so much a question of whether leadership is shared in groups, but what aspects of leadership are shared, where that sharing occurs, and how the sharing affects the group and its members. For example, weak levels of global leadership are apparently shared more easily across geographical boundaries and between different clusters of leaders, but less easily shared between members of different sexes (as denoted by a stronger level of homophily associated with sex). This might imply that strong leadership ties are more aligned with the formal hierarchy, or

that weak ties serve a different purpose than strong ties, and are subject to different social pressures or result from different schemas.

Whether the existence of emergent leadership ties that cut across cliques and geography is a good thing for organizations is a different question. In some cases – such as when informal leaders support counterproductive behaviors in the organization, or goals that are not aligned with the rest of the organization – the existence of informally shared leadership ties could have serious negative consequences for the organization. In other cases, informal leadership networks could provide social support and informational influence that the formal structure fails to provide, in which case the organization would benefit by having a broad, dense network of informal leaders. Thus, whether such networks are (on balance) a good thing or bad thing depends on the people who fill those roles, and their specific position within the larger network. Answering this question will require researchers to identify ways in which individual characteristics and network roles interact with one another.

Another, surprising finding was the relative level of symmetry and decentralization present in the leadership structure. The strong level of reciprocity present in the weak networks is in direct contrast to the traditional view of leadership as a primarily hierarchical phenomenon (Pearce & Conger, 2003), and there was no evidence for negative levels of reciprocity, even in networks based on a strong definition of leadership. The high level of reciprocity found in the strong transactional leadership network represents an especially surprising result: this network explicitly refers to relationships which are often considered to be very asymmetric: monitoring and

rewarding work performance. However, it appears that weak transactional leadership relations involve a significant level of reciprocal transaction, where transactions are not strictly one-directional (e.g., rewards for performance), but often bi-directional, where both parties play the role of transactional leader to each other, monitoring and rewarding one another.

To the extent that the networks were centralized, it was a relatively "soft" centralization, with several connected core-periphery structures based on transitive triangles as opposed to highly centralized trees and stars. This suggests the key role of triads - rather than clusters of larger size - in the study of leadership. The only exception to this pattern was in the strongly defined transactional leadership network. One possible interpretation of this result is that transactional relations are more dependent than other networks on the reward powers and legitimacy conferred by the formal organizational hierarchy, which follows a tree-like arrangement.

These results have a number of implications for theory and practice. At a general level, the results highlight some of the utility of studying leadership *networks* instead of individual leaders or the qualities of individual leader-follower dyads (Mehra, et al., 2006). Leaders do not exist in a vacuum, and the results of the current analysis provide clear evidence that leadership ties involve dyadic- and triadic-level effects, in addition to individual-level effects. The analysis also demonstrates how complicated social patterns of the sort pictured in Figure 16 can be explained by a smaller number of underlying structural features. By focusing only on individuals and independent dyadic relations, researchers studying leadership run the risk of missing important effects.

Specifically, future research may need to refocus on higher-order (e.g., triadic) levels of analysis. Leadership networks in the current study displayed a variety of complex patterns at multiple levels of analysis, many of which would not be predicted from individual or dyadic-oriented theories of leadership. For example, some of the strongest effects (e.g., transitivity, independent *k*-paths, and *k*-stars) were *triadic* effects, raising the possibility that leadership may not be a primarily an individual *or* dyadic phenomenon. Rather than focusing only on the development of leadership relations by individuals and dyads, future research may need to better account for third-party effects on emergent leadership and influence.

Another implication of the current study is that emergent leadership networks appear to be surprisingly decentralized, compared to what might be expected based on the outcomes of traditional leaderless group designs and other leader-centered research. Instead of a handful of individuals receiving the bulk of leadership nominations in a few star-like structures, nominations tended to occur in a handful of loosely organized transitive clusters, surrounded by followers who often perceived multiple leaders across different transitive structures. Instead of a system of leadership defined by a few key players who wield control over a linear hierarchy, the results suggest that emergent leadership is much more widely and evenly distributed across the organization, with tendencies for loose clusters of partially ordered, entangled heterarchies (Kontopoulos, 1993) and reciprocal dyads instead of fully-ordered tree-like structures associated with formal organizational hierarchies. In fact, the various emergent leadership structures

correlate highly with friendship, which is not a relationship known for being highly centralized in organizations.

This kind of decentralized structure implies that organizations which wish to achieve goals by leveraging the informal leadership structure may need to move beyond the formal organizational chart (Cross & Parker, 2004; Sparrowe & Liden, 1997). Instead of relying only on the leadership and influence of formal leaders and managers, organizations may need to make an extra effort to develop informal leaders who can bridge disparate leadership cliques and reach peripheral actors, or identify structural limitations in the formal structure which limit the reach or robustness of the leadership system.

For example, in the current study, females were significantly less likely to receive *and* send various types of leadership nominations. Sex barriers to being perceived as a leader are well-known (Eagly & Karau, 1991), but sex barriers to perceiving leadership in others presents a different problem, suggesting that women simply do not participate as much in the emergent leadership system as either leaders *or followers*. Moreover, the tendency to engage in reciprocal relations offers a potential explanation for these effects: if current leaders were to make an effort to recognize and accept the influence of females in the organization, the principle of reciprocity suggests that these leaders would gain additional influence by "growing" new leadership ties to female actors and incorporating them into the larger leadership structure.

A further implication of the results is that leadership and influence networks based on the same type of relations but different strengths may be subject to different

social processes. In fact, Table 4b suggests that tie strength was a more important determinant of structural characteristics than the type of leadership tie (transformational versus transactional). For strong ties, homophily due to location proved to be a stronger effect, but homophily associated with other individual differences and reciprocity was weaker or non-existent. For moderately strong ties, there were more effects associated with individual differences, weaker effects of shared location, and strong levels of reciprocity. One possibility is that the factors which influence the formation of ties are different for "strong" ties than for "weaker" ties. Another possibility is that stronger and weaker ties interact: for example, there may be social pressure for those who receive strong leadership or influence relations to reciprocate by sending "weak" nominations to their followers in a type of strong-weak exchange relation.

Finally, the results show that the various types of leadership relations displayed very similar overall patterns to one another, as well as to the global (non-specific) leadership networks. One possible implication of this is that individual perceptions of what constitute leadership tend to subsume basic aspects of both transformational and transactional leadership. While some individuals may be more prone to a "charismatic" view of leadership, and others may be more prone to a "managerial" view, the similarity in overall patterns certainly suggests the possibility that global leadership nominations may be the result of both transformational and transactional factors. The two types of leadership could also be subject to social pressures from similar sources, like organizational norms for reciprocity and sex effects, similar limitations in the opportunity for social interactions, or shared antecedent social ties, like trust.

Limitations

The results of the study, while potentially interesting, are subject to a number of limitations that affect their validity and interpretability. One of the primary limitations is that the study was only a snapshot of a single organization. This means (a) that generalizations to other organizations must necessarily be suspect, and (b) that the study cannot separate selection from influence effects, or in some cases, make definitive statements about the nature of the various structural characteristics. Thus, interpretations of the analyses must be limited in scope.

The generalizability issue is common to network studies (and to most organizational studies), which often involve the analysis of only a single network. While we cannot use such studies to make definitive statements about general tendencies across all organizations, we can use the results to point to the possibility of such tendencies. For example, while researchers would surely expect levels of reciprocity to vary across different groups, the fact that leadership nominations showed some significant signs of relational symmetry provides an important data point. It demonstrates that symmetric leadership relations are not only possible, but even probable in certain types of groups, and that centralized hierarchy is not necessarily a defining feature of leadership structures in organizations. While these results cannot tell use how most organizations are organized, they do tell us that organizations can be organized in surprising ways.

The second issue, time, is a more limiting factor in the interpretation of the current results. While these results clearly show that certain types of relational patterns in this organization are unlikely to be observed by random chance, it is not precisely

clear how such patterns tended to form. For example, reciprocity could develop synchronously or asynchronously: individuals could make or accept influence attempts at a certain time, and this tie might only be reciprocated after a long period of time; or they could look to one another for leadership simultaneously, because of common external pressures like a lack of formal leadership or an uncertain environment. The results show that the leadership network formed a loosely organized core-periphery structure, but is that structure stable or unstable? Do these transitive relations form on the basis of anticipated (future) balance at a given point in time, or on the basis of past competition between actors? All the current study can do is point out possible interpretations of the observed patterns, but these patterns may form differently over time, depending on the nature of the specific social processes that cause them to occur.

Another issue is the measurement of transformational and transactional leadership. There are a wide variety of scales designed to measure different facets of these constructs. However, due to the practical issues of data collection for a moderately large network, even the shortest traditional forms are unfeasible[20]. The sociometric items used in the study come directly from the definitions of each type of leadership, but must necessarily exclude facets and gradations in leadership ratings which longer or more formal scales would be able to capture. This raises the possibility that network studies designed to capture those extra facets or gradations of leadership would find different patterns from the current study. On that basis, it is necessary to keep in mind the specific

[20] For a network with *g* members, every actor must answer *g*-1 items for every sociometric item in the survey. In the current study, with 143 participants, each person must therefore respond to 142 items for each network question being measured.

aspects of transformational and transactional leadership being measured when interpreting the results.

A third issue is that not every potentially important variable was controlled for in the current set of models. For example, one important source of leadership nominations may be the strength of affective regard, in which case more popular individuals (e.g., those who are more central in the friendship network) may be more likely to be nominated as sources of leadership and influence. Another important source of power is location in the formal organizational hierarchy, and formal supervisor-employee relationships. The current analysis only controlled for supervisory power in a general fashion, and did not take into account the specific effects of formal organizational dyadic ties. The inclusion of these effects in future analyses could help identify the source of different relational patterns in the leadership network by more explicitly distinguishing between the effects of formal authority and informal popularity on leadership perceptions. This would help identify to what degree formal managerial power accounts for status and influence within the informally-specified leadership network.

Another important limitation has to do with the way that influence was conceptualized and measured in the study. For example, it is possible that participants conceive of influence as both a direct and indirect relationship: they might acknowledge little direct influence on the part of a given actor (for example, when there is no actual social interaction), but acknowledge and report influence they receive indirectly (for example, through reputation). The distinction between these two types of influence (direct vs. indirect) represents an important issue, since it might be expected that they

represent different aspects of influence, and arise through different processes. This may explain one source of the differences in weak/strong structures: strong ties may be capturing more direct influence than weak ties. However, without additional research, it is not possible to distinguish between the two.

The limitations point to the need for future research, and possible directions. One of the most basic extensions would be to conduct a multilevel analysis by examining multiple groups from different organizations. This could allow for the explicit assessment of network-level variability in basic structural patterns like homophily and reciprocity, and the organizational characteristics that relate to this variability (for example, industry type, organization size, geographical location, etc.). Another basic extension would be to capture network data at multiple time points. This would allow for the disentangling of selection and influence effects, and give a truly dynamic picture of the social processes occurring within the network.

Future directions

There are additional aspects of social structure which could be studied in future research. For example, instead of focusing on patterns related to low-level cohesiveness (dyads, triads, etc.), research could instead focus on identifying much more broad patterns, such as role structures. The complex patterns observed in the current study suggest that simply classifying people into “leader” and “followers” may be too simplistic; future research could try to identify the various role sets (Katz & Kahn, 1978) which might exist within the leadership structure, and how individuals in those role sets relate to one another. Instead of predicting who will be the follower and who will be the

leader, such an analysis could allow researchers to predict who will be the most influential person within a particular social role, or who will be the most likely to provide simultaneous influence to members of multiple role sets.

Another important avenue for future research is to link leadership and influence relations to other social networks in organizations, especially those for which extensive research currently exists. Relationships like trust, acquaintanceship, advice-seeking, friendship, and communication commonly appear in network studies of organizations; by including these sorts of ties in network studies of leadership, researchers could study leadership from a multiplex perspective. This would allow for the identification of relational dependencies associated with leadership and influence, in which ties like trust or respect might be "exchanged" for influence, where power brokers transform informal access to leaders into influence for themselves, or where different classes of leadership ties exist, each associated with a different combination of relationships and social characteristics.

Finally, future research must focus on the organizational outcomes associated with emergent leadership networks. Much has been written about the effects of decentralized formal structure and network forms of governance (Jones, Hesterly, & Borgatti, 1997), but little is known about the effects of informal leadership structures. Do teams with greater leadership density or reciprocity perform better than those with fewer relations? Does the type of centralization matter? Do the effects of leadership dispersion on performance differ depending on the level of analysis (workgroup, department, or organization)? How much actual influence do emergent leaders have with

followers' attitudes and behaviors? How much does the performance of an informal leader affect organizational performance, compared to the performance of a leader who occupies a formal position?

CONCLUSION

By conceptualizing leadership as a network, it is possible to identify complex structural patterns involving multiple levels simultaneously. These patterns provide information that can be used to help identify basic social processes associated with their creation or maintenance, and a path towards reconciling two different perspectives on organizational influence - psychological and structural. The results of the analysis highlight a surprising level of reciprocity and decentralization, substantial similarities across two different types of leadership networks, and differences in the patterning of strong and weak leadership relations.

REFERENCES

Alexander, C. N. (1972). Status perceptions. *American Sociological Review, 37*(6), 767-773.

Anderson, C. J., Wasserman, S., & Crouch, B. (1999). A p* primer: Logit models for social networks. *Social Networks, 21*, 37-66.

Arkin, R. M. & Burger, J. M. (1980). Effects of unit relation tendencies on interpersonal attraction. *Social Psychology Quarterly, 43*(4), 380-391.

Bales, R. F. (1958). Task roles and social roles in problem-solving groups. In E. E. Maccoby, T. M. Newcomb, & E. L. Hartley (Eds.), *Readings in social psychology* (pp. 437-447). New York: Holt, Rinehart & Winston.

Bass, B. (1999). Two decades of research and development in transformational leadership. *European Journal of Work and Organizational Psychology, 8*(1), 9-32.

Bass, B., Avolio, B., Jung, D, & Berson, Y. (2003). Predicting unit performance by assessing transformational and transactional leadership. *Journal of Applied Psychology, 88*, 207-218.

Bass, B., Waldman, D., Avolio, B., & Bebb, M. (1987). Transformational leadership and the falling dominoes effect. *Group and Organizational Studies, 12*(1), 73-87.

Berg, J., Dickhaut, J., & McCabe, K. (1994). Trust, reciprocity, and social history. *Games and Economic Behavior, 10*, 122-142.

Black, S. E., & Lynch, L. M. (2004). What's driving the new economy? The benefits of workplace innovation. *The Economic Journal, 114*, F97-F116.

Blanz, M., Mummendey, A., Mielke, R., & Klink, A. (1998). Responding to negative social identity: A taxonomy of identity management strategies. *European Journal of Social Psychology, 28*, 697-729.

Bono, J. E., & Anderson, M. H. (2005). The advice and influence networks of transformational leaders. *Journal of Applied Psychology, 90*(6), 1306-1314.

Brass, D. J. (1984). Being in the right place: A structural analysis of individual influence in an organization. *Administrative Science Quarterly, 29*, 518–539.

Brass, D. J., & Burkhardt, M. E. (1993). Potential power and power use: An investigation of structure and behavior. *Academy of Management Journal, 36*, 441-470.

Brown, R. (2000). *Group processes*. Malden, MA: Blackwell Publishing.

Brown, D. J. & Keeping, L. M. (2005). Elaborating the construct of transformational leadership: The role of affect. *The Leadership Quarterly, 16*, 245-272.

Bunderson, J. S. (2003). Recognizing and utilizing expertise in work groups: A status characteristics perspective. *Administrative Science Quarterly, 48*, 557-591.

Burns, J.M. (1978). *Leadership*. New York: Harper & Row.

Campbell, L., Simpson, J. A., Stewart, M., & Manning, J. G. (2002). The formation of status hierarchies in leaderless groups: The role of male waist-to-hip ratios. *Human Nature, 13*(3), 345-362.

Cartwright, D. & Harary, F. (1956). Structural balance: A generalization of Heider's theory. *Psychological Review, 63*(5), 277-293.

Chao, G.T., O'Leary-Kelly, A.M., Wolf, S., Klein, H.J., & Gardner, P.D. (1994).

Organizational socialization: Its content and consequences. *Journal of Applied Psychology, 79*, 730-743.

Charbonneau, D. (2004). Influence tactics and perceptions of transformational leadership. *Leadership and Organization Development, 25*(7), 565-576.

Chase, I. D. (1980). Social process and hierarchy formation in small groups: A comparative perspective. *American Sociological Review, 45*(6), 905-924.

Chepko-Sade, B. D., Reitz, K. P., & Sade, D. S. (1989). Sociometrics of Macaca Mulatta IV: Network analysis of social structure of a pre-fission group. *Social Networks, 11*, 293-314.

Chisholm, D. (1992). *Coordination without hierarchy: Informal structures in multi-organizational systems*. Los Angeles, CA: University of California Press.

Cook, K. S., Emerson, R. M., Gilmore, M. R., & Yamagishi, T. (1983). The distribution of power in exchange networks: Theory and experimental results. *American Journal of Sociology, 89*(2), 275-305.

Cronshaw, S. F., & Ellis, R. J. (1991). A process investigation of self-monitoring and leader emergence. *Small Group Research, 22*(4), 403-420.

Cross, R. & Parker, A. (2004). *The hidden power of social networks: Understanding how work really gets done in organizations*. Boston, MA: Harvard Business School Press.

Daft, R. L., & Lewin, A. Y. (1993). Where Are the Theories for the 'New' organizational Forms? An Editorial Essay. *Organization Science, 4*, i-iv.

Davis, J. A. (1963). Structural balance, mechanical solidarity, and interpersonal

relations. *American Journal of Sociology, 68*(4), 444-462.

Day, D. V., Gronn, P., & Salas, E. (2004). Leadership capacity in teams. *The Leadership Quarterly, 15*, 857-880.

Degenne, A. & Forse, M. (1999). *Introducing social networks*. London: Sage Publications.

de Nooy, W. (1999). The sign of affection: Balance theoretic models and incomplete signed digraphs. *Social Networks, 21*, 269-286.

De Souza, G., & Klein, H. J. (1995). Emergent leadership in the group goal-setting process. *Small Group Research, 26(4)*, 475-496.

Dumaine, B. (1990, May). Who needs a boss? *Fortune*, 52-60.

Dunning, D. (1999). A newer look: Motivated social cognition and the schematic representation of social concepts. *Psychological Inquiry, 10*(1), 1-11.

Eagly, A. H., & Karau, S. J. (1991). Gender and the emergence of leaders: A meta-analysis. *Journal of Personality and Social Psychology, 60*(5), 685-710.

Evans, P. & Wolf, B. (2005, July). Collaboration rules. *Harvard Business Review*, 96-104.

Faust, K. (2007). Very local structure in networks. *Sociological Methodology, 37*(1), 209-256.

Feld, S. L., & Elmore, R. (1982). Patterns of sociometric choices: Transitivity reconsidered. *Social Psychology Quarterly, 45*(2), 77-85.

Ferligoj, A. & Hlebec, V. (1999). Evaluation of social network instruments. Social Networks, 21, 111-130.

Fernandez, R. M. (1991). Structural bases of leadership in intraorganizational networks. *Social Psychology Quarterly, 54(1)*, 36-53.

Fisek, M. H., Berger, J, & Norman, R. Z. (1991). Participation in hetergeneous and homogeneous groups: A theoretical integration. *American Journal of Sociology, 97*(1), 114-142.

Fisk, S. T. (1993). Social cognition and social perception. *Annual Review of Psychology, 44*, 155-194.

Fombrun, C. J. (1983). Attribution of power across a social network. *Human Relations, 36*(6), 493-507.

Ford, L. R. (2003). Within-group agreement in perception of the work environment: Its antecedents. Doctoral dissertation, Virginia Commonwealth University, Richmond.

Freeman, L., Roeder, D., & Mulholland, R. (1980). Centrality in social networks: II. Experimental results. *Social Networks, 2*, 119-141.

Friedkin, N. E. (1993). Structural bases of interpersonal influence in groups: A longitudinal case study. *American Sociological Review, 58*, 861-872.

Gardner, W. L., Pickett, C. L. & Brewer, M. B. (2000). Social exclusion and selective memory: How the need to belong influences memory for social events. *Personality and Social Psychology Bulletin, 26*, 486-496.

Gould, R. V. & Fernandez, R. M. (1989). Structures of mediation: A formal approach to brokerage in transaction networks. *Sociological Methodology, 19*, 89-126.

Graen, G. & Uhl-Bien, M. (1995). Relationship-based approach to leadership:

Development of leader-member exchange (LMX) theory of leadership over 25 years: Applying a multi-level multi-domain perspective. *The Leadership Quarterly, 6*(2), 219-247.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology, 78*(6), 1360-1380.

Gronn, P. (2002). Distributed leadership as a unit of analysis. *The Leadership Quarterly, 13*, 423-451.

Hains, S. C., Hogg, M. A., & Duck, J. M. (1997). Self-categorization and leadership: Effects of group prototypicality and leader stereotypicality. *Journal of Personality and Social Psychology, 23*(10), 1087-1099.

Hamilton, D. L., & Sherman, S. J. (1996). Perceiving persons and groups. *Psychological Review, 103*(2), 336-355.

Han, S. (1996). Structuring relations in on-the-job networks. *Social Networks, 18(1)*, 47-67.

Heald, M. R., Contractor, N. S., Koehly, L. M., & Wasserman, S. (1998). Formal and emergent predictors of coworkers' perceptual congruence on an organization's social structure. *Human Communication Research, 24*, 536-563.

Heider, F. (1958). *The psychology of interpersonal relations*. New York: John Wiley & Sons.

Hogan, R., Curphy, G. J., & Hogan, J. (1994). What we know about leadership: Effectiveness and personality. *American Psychologist, 49*(6), 493-504.

Hogg, M. (2001). A social identity theory of leadership. *Personality and Social*

Psychology Review, 5(3), 184-200.

Hollander, E. P., & Offermann, L. R. (1990). Power and leadership in organizations: Relationships in transition. *American Psychologist, 45*(2), 179-189.

House, R. J. & Aditya, R. N. (1997). The social scientific study of leadership: Quo vadis? *Journal of Management, 23*(3), 409-473.

Howell, J. M. & Higgins, C. A. (1990). Champions of technological innovation. *Administrative Science Quarterly, 35*(2), 317-341.

Hummon, N. P. & Doreian, P. (2003). Some dynamics of social balance processes: Bringing Heider back into balance theory. *Social Networks, 25*, 17-49.

Ibarra, H. (1993). Personal networks of women and minorities in management: A conceptual framework. *Academy of Management Review, 18*, 56-57.

Ibarra, H., & Andrews, S. (1993). Power, influence, and sensemaking: Effects of network centrality and proximity on employee perceptions. *Administrative Science Quarterly, 38*, 277-303.

Ilgen, D. R., & Hollenbeck, J. R. (1991). The structure of work: Job design and roles. In M. D. Dunnette & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd ed., Vol. 2, pp. 165-207). Palo Alto, CA: CPP.

Jameson, S. H. (1945). Principles of social interaction. *American Sociological Review, 10*(1), 6-12.

Johnson, J. C., & Orbach, M. K. (2002). Perceiving the political landscape: Ego biases in cognitive networks. *Social Networks, 24*, 291-310.

Johnson, S., & Bechler, C. (1998). Examining the relationship between listening

effectiveness and leadership emergence: Perceptions, behavior, and recall. *Small Group Research, 29*(4), 452-471.

Jones, C., Hesterly, W. S., & Borgatti, S. P. (1997). A general theory of network governance: Exchange conditions and social mechanisms. *Academy of Management Review, 22*(4), 911-945.

Jost, J. T., Banaji, M. R., & Nosek, B. A. (2004). A decade of system justification theory: Accumulated evidence of conscious and unconscious bolstering of the status quo. *Political Psychology, 25*(6), 881-920.

Jou, Y. H., & Fukada, H. (2002). Stress, health, and reciprocity and sufficiency of social support: The case of university students in Japan. *Journal of Social Psychology, 142*(3), 353-370.

Judge, T. A., Bono, J. E., Ilies, R., & Gerhardt, M. W. (2002). Personality and leadership: A qualitative and quantitative review. *Journal of Applied Psychology, 87*(4), 765-780.

Katz, D., & Kahn, R. L. (1978). *The social psychology of organizations*. New York: Wiley.

Kenny, D. A. & Zaccaro, S. J. (1983). An estimate of variance due to traits in leadership. *Journal of Applied Psychology, 68*(4), 678-685.

Kickul, J., & Neuman, G. (2000). Emergent leadership behaviors: The function of personality and cognitive ability in determining teamwork performance and KSAs. *Journal of Business and Psychology, 15(1)*, 27-51.

King-Casis, B., Tomlin, D., Cedric, A., Camerer, C. F., Quartz, S. R., Montague, R.

(2005). Getting to know you: Reputation and trust in a two-person economic exchange. *Science, 308*, 78-83.

Koehly, L.M. & Pattison, P. (2005). Random graph models for social networks: Multiple relations or multiple raters. In P. Carrington, J. Scott, & S. Wasserman (Eds.), *Models and methods in social network analysis*. New York: Cambridge University Press.

Kontopoulos, K. M. (1993). *The logics of social structure*. New York: Cambridge University Press.

Krackhardt, D. (1987). Cognitive social structures. *Social Networks, 9*, 109-134.

Krackhardt, D. (1990). Assessing the political landscape: Structure, cognition, and power in organizations. *Administrative Science Quarterly, 35*, 342-369.

Krackhardt, D. (1994). Graph Theoretical Dimensions of Informal Organizations. In K. M. Carley and M. J. Prietula (Eds.), *Computational Organization Theory*, (pp. 89-111). Hillsdale, NJ: Lawrence Erlbaum and Associates.

Krackhardt, D., & Brass, D. (1994). Intraorganizational networks: The micro side. In S. Wasserman & J. Galaskiewicz (Eds.), *Advances in social network analysis: Research from the social and behavioral sciences* (pp. 207-229). Thousand Oaks, CA: Sage.

Krackhardt , D. & Stern, R. (1988). Informal networks and organizational crises: An experimental simulation. *Social Psychology Quarterly, 51*, 123-140.

Kuhnert, K. W., & Lewis, P. (1987). Transactional and transformational leadership: A constructive/developmental analysis. *Academy of Management Review, 12*(4),

648-657.

Laumann, E. O., & Marsden, P. (1982). Microstructural analysis in interorganizational systems. *Social Networks, 4*, 329-348.

Lawler, E. J. (1975). An experimental study of factors affecting the mobilization of revolutionary coalitions. *Sociometry, 38*(2), 163-179.

Lazega, E., & Pattison, P. (1999). Multiplexity, generalized exchange, and cooperation in organizations: A case study. *Social networks, 21*, 67-90.

Lord, R., DeVader, C., & Alliger, G. (1986). A meta-analysis of the relationship between personality traits and leadership perceptions: An application of validity generalization procedure. *Journal of Applied Psychology, 71*, 402-410.

Lord, R., Foti, R., & de Vader, C. (1984). A test of leadership categorization theory: Internal structure, information processing, and leadership perceptions. *Organizational Behavior and Human Performance, 34*(3), 343-378.

Madden, T. (2001). The role of influence in leader emergence in self-directed work teams. Doctoral dissertation, Boston College, Boston.

Mahar, C., & Maher, T. (2003). Emergent leadership: Toward an empirically verifiable model. (CFLI Contract Research Report #CR02-0615). Kingston, ON: Canadian Forces Leadership Institute.

Mannix, E. A. (1993). Organizations as resource dilemmas: The effects of power balance on coalition formation in small groups. *Organizational Behavior and Human Decision Processes, 55*(1), 1-22.

Marsden, P. (1982). Brokerage behavior in restricted exchange networks. In P. Marsden

& N. Lin (Eds.), *Social structure and network analysis*, (pp. 208-218). Beverly Hills, CA: Sage.

Matheiu, J., Goodwin, G., Heffner, T., Salas, E., & Cannon-Bowers, J. (2000). The influence of shared mental models on team process and performance. *Journal of Applied Psychology, 85(2)*, 273-283.

Mayo, M., Meindl, J., & Pastor, J. (2003). Shared leadership in work teams. In C. Pearce & J. Conger (Eds.), *Shared leadership* (pp. 193-214). Thousand Oaks, CA: Sage Publications.

McBride, M. (2006). Imperfect monitoring in communication networks. *Journal of Economic Theory, 126*(1), 97-119.

Mehra, A., Smith, B., Dixon, A., & Robertson, B. (2006). Distributed leadership in teams: The network of perceptions and team performance. *The Leadership Quarterly*.

Meindl, J. R. (1990). On leadership: An alternative to the conventional wisdom. In B. M. Staw & L. L. Cummings (Eds.), *Research in organizational behavior*, Vol. 12, (pp. 159-203). Greenwich, CT: JAI Press.

Meindl, J. R. (1993). Reinventing leadership: A radical, social psychological approach. In J. K. Murnighan (Ed.), *Social psychology in organizations*, (pp. 159-203), Englewood Cliffs, NJ: Prentice Hall.

Meindl, J. R. (1995). The romance of leadership as follower-centric theory: A social constructionist approach. *Leadership Quarterly, 6*, 329-341.

Michener, H. A. & Lyons, M. (1972). Perceived support and upward mobility as

determinants of revolutionary coalitional behavior. *Journal of Experimental and Social Psychology, 8*, 180-195.

Michener, H. A. & Zeller, R. A. (1972). The effect of coalition strength on the formation of contractual norms. *Sociometry, 35*(2), 290-304.

Monge, P., & Contractor, N. (2003). *Theories of communication networks*. New York: Oxford University Press.

Mullen, B., Johnson, C., & Salas, E. (1991). Effects of communication network structure: Components of positional centrality. *Social Networks, 13(2),* 169-185.

Neubert, M. J. (1999). Too much of a good thing or the more the merrier? Exploring the dispersion and gender composition of informal leadership in manufacturing teams. *Small Group Research, 30*(5), 635-646.

Offermann, L. R., Kennedy, J. K., & Wirtz, P. W. (1994). Implicit leadership theories: Content, structure, and generalizability. *The Leadership Quarterly, 5*(1), 43-58.

Oldmeadow J., Platow, M. J., Foddy, M., & Anderson, D. (2003). Self-categorization, status, and social influence. *Social Psychology Quarterly, 66*(2), 138-152.

Osbourn, R. N., Hunt, J. G., & Jauch, L. R. (2002). Toward a contextual theory of leadership. *Leadership Quarterly, 13*, 797-837.

Palich, L., & Hom, P. (1992). The impact of leader power and behavior on leadership perceptions. *Group and Organization Management, 17*(3), 279-296.

Pastor, J., Meindl, J. R., & Mayo, M. C. (2002). A network effects models of charisma attributions. *Academy of Management Journal, 45(2)*, 410-420.

Pattison, P. (1994). Social cognition in context: Some applications of social network

analysis. In S. Wasserman & J. Galaskiewicz (Eds.), *Advances in social network analysis: Research from the social and behavioral sciences* (pp. 79-109). Thousand Oaks, CA: Sage Publications, Inc.

Pearce, C., & Conger, J. (2003). All those years ago: The historical underpinnings of shared leadership. In C. Pearce & J. Conger (Eds.), *Shared leadership* (pp. 1-18). Thousand Oaks, CA: Sage Publications.

Peyton, M. E., Greenstone, M. H., & Schenker, N. (2003). Overlapping confidence intervals or standard error intervals: What do they mean in terms of statistical significance? *Journal of Insect Science, 3*, 1-6.

Popper, M. (2004). Leadership as a relationship. *Journal for the Theory of Social Behavior, 34*(2), 107-125.

Pye, A. (2005). Leadership and organizing: Sensemaking in action. *Leadership, 1*(1), 31-50.

Raelin, J. (2004). Don't bother putting leadership into people. *Academy of Management Executive, 18*(3), 131-135.

Ravlin, E. C., & Thomas, D. C. (2005). Status and stratification processes in organizational life. *Journal of Management, 31*(6), 966-987.

Rifkin, G. (1996, April). Leadership: Can it be learned? *Forbes*, 100-112.

Riggio, R. E., Riggio, H. R., Salinas, C., & Cole, E. J. (2003). The role of social and emotional communication skills in leader emergence and effectiveness. *Group Dynamics: Theory, Research, and Practice, 7*(2), 83-103.

Robins, G., Pattison, P., & Woolcock, J. (2005). Small and other worlds: Global network

structure from local processes. *American Journal of Sociology, 110*(4), 894-936.

Roethlisberg, F. J. & Dickson, W. J. (1939). *Management and the worker.* Oxford, England: Harvard University Press.

Sade, D. S. & Dow, M. M. (1994). Primate social networks. In S. Wasserman & J. Galaskiewicz (Eds.), *Advances in social network analysis: Research from the social and behavioral sciences* (pp. 152-166).

Schneider, M., Graham, J., Bauer, A., Bessiere, K., & Gonzalez, C. (2004, September) Shared mental models in military command and control organizations: Effect of social network distance. *Proceedings of the Human Factors and Ergonomics Society 48th Annual Meeting, New Orleans, LA*.

Sell, J., Lovaglia, M. J., Mannix, E., Samuelson, C. D., & Wilson, R. K. (2004). Investigating conflict, power, and status within and among groups. *Small Group Research, 35*(1), 44-72.

Shelley, R. K. & Troyer, L. (2001). Emergence and completion of structure in initially undefined and partially defined groups. *Social Psychology Quarterly, 64*(4), 318-332.

Showers, C. & Cantor, N. (1985). Social cognition: A look at motivated strategies. *Annual Review of Psychology, 36*, 275-305.

Simpson, B. & Macy, M. W. (2001). Collective action and power inequality: Coalitions in exchange networks. *Social Psychology Quarterly, 64*(1), 88-100.

Simpson, B. & Walker, H. A. (2002). Status characteristics and performance expectations: A reformulation. *Sociological Theory, 20*(1), 24-40.

Skvoretz, J., Faust, K. & Fararo, T. J. (1997). Social structure, networks, and E-state structuralism models. In P. Doreian & F. N. Stokman (Eds.), *Evolution of social networks* (pp. 129–147). Amsterdam: Gordon and Breach.

Snijders, T. A. B., Pattison, P. E., Robins, G. L., & Handcock, M. (2006). New specifications for exponential random graph models. *Sociological Methodology, 36*, 99-153.

Snijders, T. A. B., Steglich, C., Schweinberger, M. and Huisman, M. (2007). *Manual for SIENA version 2*. Groningen: ICS, University of Groningen.

Sorrentino, R. (1973). An extension of theory of achievement motivation to the study of emergent leadership. *Journal of Personality and Social Psychology, 26*(3), 356-368.

Sorrentino, R. & Field, N. (1986). Emergent leadership over time: The functional value of positive motivation. *Journal of Personality and Social Psychology, 50*(6), 1091-1099.

Sparrowe, R., & Liden, R. (1997). Process and structure in leader-member exchange. *Academy of Management Review, 22*, 522–552.

Taggar, S., Hackett, R., & Saha, S. (1999). Leadership emergence in autonomous work teams: Antecedents and outcomes. *Personnel Psychology, 52*, 899-926.

Takahashi, N. (2000). The emergence of generalized exchange. *American Journal of Sociology, 105*(4), 1105-1134.

Thurmaier, K., & Wood, C. (2002). Interlocal agreements as overlapping social networks: Picket-fence regionalism in metropolitan Kansas City. *Public*

Administration Review, 62(5), 585-598.

Thye, S. R., Willer, D., & Markovsky, B. (2006). From status to power: New models at the intersection of two theories. *Social Forces, 84*(3), 1471-1495.

Torpman, J. (2004). The differentiating function of modern forms of leadership. *Management Decision, 42*(7), 892-906.

Uhl-Bien, M. & Maslyn, J. M. (2003). Reciprocity in manager-subordinate relationships: Components, configurations, and outcomes. *Journal of Management, 29*(4), 511-532.

Van Beest, I., Van Dijk, E., De Dreu, C. K. W., & Wilke, H. A. M. (2005). Do-no-harm in coalition formation: Why losses inhibit exclusion and promote fairness cognitions. *Journal of Experimental Social Psychology, 41*, 609-617.

Van de Bunt, G., Van Duijn, M. A. T., & Snijders, T. A. B. (1999). Friendship networks through time: An actor-oriented dynamic statistical approach. Computational and Mathematical Organizational Theory, 5(2), 167-192.

Van Doorn, G. S., Hengeveld, G. M., & Weissing, F. J. (2003). The evolution of social dominance II: Multi-player models. *Behavior, 140*, 1333-1358.

Wasserman, S. & Faust, K. (1994). *Social network analysis: Methods and applications*. New York: Cambridge University Press.

Wasserman, S. & Galaskiewicz, J. (1994). *Advances in social network analysis: Research from the social and behavioral sciences*. Thousand Oaks, CA: Sage Publications.

Wasserman, S. & Robins, G. (2005). An introduction to random graphs, dependence

graphs, and p*. In P. Carrington, J. Scott, & S. Wasserman (Eds.), *Models and methods in social network analysis*. New York: Cambridge University Press.

Watson, C. & Hoffman, L. R. (2004). The role of task related behavior in the emergence of leaders: The dillema of the informed woman. *Group and Organization Management, 29*(6), 659-685.

Watts, D. J. & Strogatz, S. H. (1998). Collective dynamics of 'small world' networks. *Nature, 393*, 440-442.

Weiss, H. M. & Adler, S. (1981). Cognitive complexity and the structure of implicit leadership theories. *Journal of Applied Psychology, 66*(1), 69-78.

Westphal, J. D. & Stern, I. (2006). The other pathways to the boardroom: Interpersonal influence behavior as a substitute for elite credentials and majority status in obtaining board appointments. *Administrative Science Quarterly, 51*(2), 169-204.

Wheelan, S. A. & Johnston, F. (1996). The role of informal leaders in a system containing formal leaders. *Small Group Research, 27*(1), 33-55.

Woods, P. A., Bennett, N., Harvey, J. A., & Wise, C. (2004). Variabilities and dualities in distributed leadership: Findings from a systematic literature review. *Educational Management Administration and Leadership, 32*(4), 439-457.

Yukl, G. (1989). Managerial leadership: A review of theory and research. *Journal of Management, 15*(2), 251-289.

Yukl, G. (1998). *Leadership in organizations*, 4th ed. Englewood Cliffs, NJ: Prentice-Hall.

Yukl, G., & Van Fleet, D. (1992). Theory and research on leadership in organizations. In

M.D. Dunnette, & L.M. Hough (Eds.), *Handbook of industrial and organizational psychology* (pp. 147-197). Palo Alto, CA: Consulting Psychologists Press.

Zaccaro, S. J., Foti, R. J., & Kenny, D. A. (1991). Self-monitoring and trait-based variance in leadership: An investigation of leader flexibility across multiple group situations. *Journal of Applied Psychology,76*, 308-315.

Zwijze-Koning, K. H. & de Jong, M. D. T. (2005). Auditing information structures in organizations: A review of data collection techniques for network analysis. *Organizational Research Methods, 8(4)*, 429-453.

APPENDIX A

SELECTED GLOSSARY OF BASIC NETWORK TERMS

Actor:	Individual node in a network. Could represent an individual, group, or entire organization, depending on the level of analysis.
Centrality:	Generally speaking, a node-level measure of importance or power in the network. Can be as simple as popularity (number of incoming ties each node receives) or as complex as eigenvector centrality (in which each actor's centrality is weighted by the centrality of their connections). The precise interpretation of the meaning of a particular measure of centrality will depend on what the tie represents as well as the type of centrality being measured.
Centralization:	Most commonly, refers to the extent to which a given network is centralized, usually operationalized in terms of the variance in centrality scores of individual actors, such that highly centralized graphs (such as a star network) will have large centralization indeces.
Clique:	Different operationalizations of cliques exist, but the term generally refers to a particular set of actors that are tightly connected to one another, but not necessarily connected to those outside the clique.
Density:	The extent to which the number of ties that *could* exist in the network are actually observed.
Dyad:	A pair (2) of nodes. Examples of common dyads would be husband and wife, student and teacher, or supervisor and employee.
Graph/network:	The set of actors and relationships between them.
Tie:	The relationship that links nodes in the network. In social networks, this is usually some type of formal or informal social relationship, but the concept can be extended to include ties defined on the basis of things like common memberships, for example.
Triad:	A set of nodes taken three (3) at a time. The smallest unit that allows for the representation of third-party effects and certain types of clustering.

APPENDIX B

FACTOR ANALYSIS OF LEADERSHIP RELATIONS

To better explore the relationship between the various emergent ties, several CFA models were tested using the correlations within each class of relationships (strong and weak). Table A1 below describes the different models tested. All models appeared to fit the data well, but AIC suggested that Model 3 provided the best fit for both strong and weak relationships. Model fit criteria are shown in Table A2, and parameter estimates are shown in Table A3 and A4.

All models appeared to fit the data well; RMR and RMSEA criteria suggested Model 3 fit the best in both strong and weak relations. AIC suggested the best-fitting model was Model 1, but that this fit was not incrementally better (> 2) than the next best-fitting model, Model 3. These results support a model with three highly correlated leadership factors, and a single friendship factor.

Table B1: CFA models

Model	Description
1	Single relationship factor, encompassing both friendship and leadership.
2	One leadership factor, plus a correlated single-indicator friendship factor.
3	Four correlated factors for each type of leadership and friendship.
4	Four lower-order factors, plus a single higher-order factor.

Table B2: Model fits

Weak relationships

Model	RMR	RSMEA AIC	NNFI	NFI	R1	D2	
1	.03	.07	-4.6	.98	.97	.96	.99
2	.03	.08	-2.6	.98	.97	.95	.99
3	**.02**	**.06**	**-3.4**	**.98**	**.98**	**.96**	**.99**
4	.02	.08	-0.5	.97	.98	.95	.99

Strong relationships

Model	RMR	RSMEA AIC	NNFI	NFI	R1	D2	
1	.03	.07	-5.1	.98	.97	.95	.99
2	.03	.07	-3.1	.98	.97	.95	.99
3	**.02**	**.05**	**-5.1**	**.99**	**.98**	**.96**	**.99**
4	.02	.07	-2.3	.98	.98	.95	.99

Table B3: Standardized factor loadings and factor correlations for Model 3 (weak)

	Factors			
	Overall	Transformational	Transactional	Friendship
Friendship				1.0 (fixed)
Leadership	.89			
Influence	.86			
Role-modeling		.89		
Goal-setting		.87		
Monitoring			.82	
Rewarding			.86	
Factor correlations				
Overall				
Transformational	.99			
Transactional	.91	.91		
Friendship	.67	.63	.60	

Table B4: Standardized factor loadings and factor correlations for Model 3 (strong)

	Factors			
	Overall	Transformational	Transactional	Friendship
Friendship				1.0 (fixed)
Leadership	.89			
Influence	.82			
Role-modeling		.88		
Goal-setting		.86		
Monitoring			.81	
Rewarding			.87	
Factor correlations				
Overall				
Transformational	.98			
Transactional	.89	.90		
Friendship	.51	.49	.49	

APPENDIX C

QUESTIONNAIRE SAMPLE

SOCIAL NETWORK QUESTIONNAIRE
In every organization, basic social dynamics lead to complex patterns of interpersonal relationships. By identifying these patterns (sometimes referred to as "social networks"), researchers can tell a lot about the social dynamics of organizations.

On the next several pages, you will be asked about your perceptions of several common social ties you might have with other people in your organization, described below:

1. **Influence** – To what extent do other people in the organization influence your opinions, attitudes, or behaviors?
2. **Leadership** – To what extent do other people provide you with what *you* consider to be leadership?
3. **Goal-setting** – To what extent do particular people help you set what *you consider* to be more difficult or higher goals for yourself?
4. **Role-modeling** – To what extent do particular people act as a role model to you in some way?
5. **Rewards** – To what extent do other individuals recognize or reward your performance? Please note that this includes **informal** rewards such as congratulations, praise, or encouragement.
6. **Monitoring** – To what extent do other individuals monitor your performance or notice how you do your job? This includes **informal** monitoring, for example, a co-worker noticing that you have been doing your job using a different method or technique than usual.
7. **Friendship** – To what extent would you describe other individuals in the organization to be a friend?

You don't need to describe your relationship with every person in the organization – just people you're familiar with. For people you **are** familiar with, please respond to items 1 to 7 using the scale provided (**1 = Not at all, 2 = Somewhat, 3 = Extensively**).

If you aren't clear about the meaning of a term or item, please refer back to this page for the description, or use your best judgment.

EXAMPLE

Say you are describing your relationship with a person named "Jo." If you think Jo tends to influence you a lot, you might circle a "3" for item (1) before completing the other items, as shown below. If you aren't familiar with Jo, you might skip the items for her entirely, and move on to the next person on the list you are familiar with.

	(1) **INFLUENCES** you	(2) Provides you with **LEADERSHIP**	(3) Influences you to **SET HIGHER GOALS**	(4) Provides a **ROLE MODEL** for you	(5) **REWARDS** (formally or informally) your performance	(6) **MONITORS** your performance	(7) Is a **FRIEND**
"Jo"	1 2 ③	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

Instructions: For each item (1-7), circle the response that best describes your relationship with people in the organization you're familiar with. **You DON'T need to answer items for every person on the list** – for example, if you're only familiar with 10 people in the organization, then you would only respond to items for those 10 people. You don't need to answer questions about yourself. Use the following scale:

1 = Not at all, 2 = Somewhat, 3 = Extensively

Names (by location)	(1) **INFLUENCES** you	(2) Provides you with **LEADERSHIP**	(3) Influences you to **SET HIGHER GOALS**	(4) Provides a **ROLE MODEL** for you	(5) **REWARDS** (formally or informally) your performance	(6) **MONITORS** your performance	(7) Is a **FRIEND**
LOCATION 1							
NAME 1	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
NAME 2	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
NAME 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
NAME 4	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
NAME 5	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
NAME 6	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
NAME 7	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
NAME 8	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

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RESEARCH INTERESTS

Social network analysis

Organizational relationships and social structure
Network models of contagion, influence, and selection in organizations
Cognitive social structures / social cognition

Research methods

Exponential random graph models
Social influence / spatial regression modeling

Measurement and selection

Individual differences (personality, cognitive ability)
Scale development